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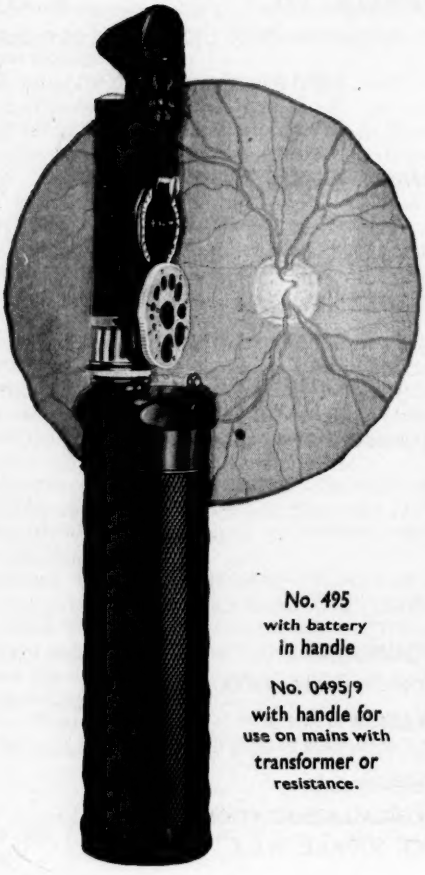

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Brit. J. Ophthal. (1958) **42**, 705.

COMMUNICATIONS

EXPERIMENTAL TRACHOMA PRODUCED BY CULTURED VIRUS

BY

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BECAUSE it has been authoritatively estimated that a quarter of the inhabitants of the globe are affected by trachoma and because this disease undoubtedly results in more visual incapacity than any other, it is difficult to over-stress the importance of the isolation of the causative agent. The aetiological role of the virus can be proved only by its isolation from trachomatous patients, its serial passage in the laboratory, the subsequent demonstration of its ability to reproduce the clinical picture of trachoma with the development of typical cytoplasmic inclusion bodies, and the re-isolation of the virus. Since animal inoculations in this disease give atypical results, it is unfortunately necessary in the present state of our knowledge to use human volunteers for this purpose.

In a previous paper (Collier and Sowa, 1958) the isolation of viruses from cases of trachoma in Gambia was described, using a technique employed by T'ang, Chang, Huang, and Wang (1957), whereby the virus was grown in the yolk-sac of embryonate eggs. In its morphological and serological characteristics the virus closely resembles those of the psittacosis-lymphogranuloma group (Fig. 1). It is interesting that the virus has been

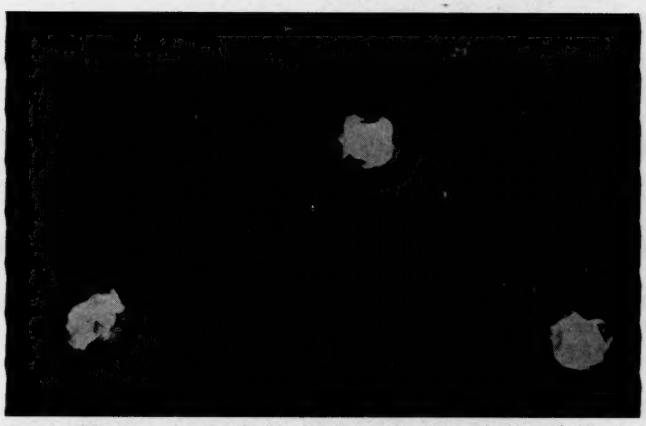

FIG. 1.—Electron-micrograph showing three elementary bodies of the virus of trachoma (strain G1: 8th egg passage). ×36,000.

recovered from a large proportion of trachomatous subjects in Gambia. In a series of 25 cases diagnosed clinically as trachomatous according to the criteria laid down by the World Health Organization Expert Committee (1956), fourteen were found to have inclusion bodies, and from all fourteen cases virus was recovered. Among the remaining eleven cases which were inclusion-negative, the virus was recovered from five. In fourteen clinically normal controls no virus was recovered.

In the paper noted, the preliminary results were given of an experiment in which a human volunteer was inoculated with one of the viruses isolated in Gambia (called the G1 strain). This volunteer has now been observed, untreated, for 7 months, and the present communication describes in detail the clinical findings and laboratory investigations. An account is also given of a second (and third) human inoculation experiment yielding equivocal results.

Material and Methods

Virus.—The G1 strain, isolated from a trachomatous patient in the Gambia (Collier and Sowa, 1958), was used for inoculation.

Inoculum.—For both experiments, virus of the 8th egg passage was used. Infected yolk sacs, showing numerous elementary bodies in Giemsa-stained smears, were blended for 1 min. in an M.S.E. homogenizer with four times their weight of 10 per cent. broth-saline. The resulting 20 per cent. (W/W) suspensions were used to inoculate the left eyes of the volunteers. In Experiment I, the yolk sac was stored at −35° C. for 3 days before making the suspension, and the latter was kept at 4° C. for 2 days before use. In Experiment II the yolk sac was stored at −35° C. for 9 days before blending, and the final suspension was used on the day of preparation.

Titration of Inocula.—Serial dilutions of infected yolk-sac suspension were made in 10 per cent. broth-saline, and 0·25 ml. of each dilution was injected into groups of embryonate eggs by the yolk-sac route. In Experiments I and II, 7-day and 9-day embryos were used respectively for the titrations. This is the only method of assay at present available, and does not always yield consistent results. It is not yet clear whether this is due to variation in the susceptibility of the eggs or to auto-interference due to the presence of relatively large amounts of non-infective virus. For this reason, the infectivity of the inocula used cannot be given in terms of 50 per cent. end-points; the protocols of the titration of inocula used for Experiments I and II are given in full in Table I (opposite). Deaths occurring within 48 hours after inoculation were regarded as non-specific, and are not included in the Table.

Control Yolk-Sac Suspensions.—20 per cent. suspensions of normal yolk sac, prepared as already described, were used to inoculate the right eyes of both subjects.

TABLE I

TITRATIONS OF INOCULA USED IN EXPERIMENTS I AND II

Dilution of Inoculum	Eggs Infected/Eggs Inoculated	
	Experiment I	Experiment II
10^{0}	2/3	1/5
10^{-1}	3/4	0/4
10^{-2}	2/3	0/5
10^{-3}	2/5	0/5
10^{-4}	4/5	0/5

Bacteriological Sterility Tests.—After harvesting, smears of all yolk sacs were stained by Gram's method; no bacteria were found. Digest broth and Brewer's thioglycollate media seeded with portions of yolk sac showed no bacterial growth after incubation at 37° C. for 5 days. Confirmatory tests, made by seeding the final suspensions onto 5 per cent. horse-blood agar plates, were negative.

Inoculation Technique.—After the conjunctiva had been anaesthetized by the instillation of 4 per cent. cocaine, the left upper lid was everted and the tarsal conjunctiva and upper fornix were rubbed firmly with a small cotton-wool swab moistened with the infected yolk-sac suspension. The right eye was similarly treated with normal yolk-sac suspension.

Examinations for Inclusions.—After the instillation of 4 per cent. cocaine, the lids were everted and scraped with a small metal spatula. The material obtained was spread on a slide, allowed to dry, and stained by two methods.

(*i*) *Iodine Staining* was done by the method of Smith, Gilkes, and Sowa (1958). After examination the slides were decolorized by overnight immersion in absolute methyl alcohol and then stained with Giemsa–May–Grünwald as described below.

(*ii*) *Giemsa–May–Grünwald Staining.*—After fixation in absolute methyl alcohol, the smears were immersed for 18 hrs in the following solution:

Giemsa stain (Gurr's R 66)	1·0 per cent.
May–Grünwald stain (Gurr)	0·5 per cent.
Distilled water buffered at pH 6·8 ..	98·5 per cent.

After staining, the slides were washed in buffered distilled water and then rapidly in 95 per cent. methyl alcohol, after which they were again transferred to buffered distilled water for several minutes before being dried.

Virus Isolation.—In Experiment I, up to and including 65 days after inoculation, a swab was rubbed over the conjunctiva and placed in 0·5 ml. nutrient broth containing 1,000 μg. streptomycin. After this material had been kept on ice for about 4 hrs, the fluid, including that squeezed from the swab, was used to inoculate embryos by the yolk-sac route. Separate groups of three embryos were inoculated with material from the right and left conjunctivae respectively. This procedure was also followed throughout Experiment II. After the 65th day of Experiment I, conjunctival scrapings were added to 0·5 ml. 0·85 per cent. saline containing 10,000 μg. streptomycin. After storage on ice for 4 hrs, 0·5 ml. 0·85 per cent.

saline was added, and the material repeatedly drawn up and down in a syringe and needle to break up cell clumps. The suspension was then distributed equally among three eggs as described above.

Complement-Fixation Tests.—These were done by a plate method, based on those of Fulton and Dumbell (1949) and Belyavin (1953). Sera were preserved with sodium azide and stored at 4° C. They were inactivated at 56° C. for 30 min. before use. Trachoma virus antigens were prepared from infected yolk sacs. After the virus had been partially purified by differential centrifugation, it was heated at 100° C. for 20 min. LGV-psittacosis group antigen, similarly prepared from psittacosis virus, was supplied by Professor Barwell. Richardson's preserved complement was diluted to contain 2 MHD per unit volume used in the test.

Haemolytic System.—Sheep cells were thrice washed and diluted to 0·5 per cent. (V/V) with 0·85 per cent. saline. They were sensitized for 20 min. at room temperature with an equal volume of haemolysin diluted to contain 10 MHD per unit volume.

Diluent.—All reagents, except the sheep cells, were diluted in calcium-magnesium saline.

In the test, the unit volume was 0·05 ml., dispensed by dropping pipettes. One vol. each of serum, complement, and antigen were added in this order to the appropriate square on the perspex plates, and the plates were then left overnight at 4° C. in a moisture-saturated atmosphere. On the following day two vols sensitized cell suspension were added to each square, and the plates were held at 37° C. in a moist atmosphere for 35 minutes. The degree of lysis in each square was then observed. The serum titre was taken as the highest dilution giving complete (+ + + +) or almost complete (+ + +) fixation. Appropriate controls for all reagents were included in each test.

Results

Experiment I

The blind volunteer was a white man, aged 71, whose right and left eyes were enucleated in 1955 and 1957 respectively after loss of sight from lens-induced uveitis with secondary glaucoma, following a blow on the right eye in 1954. His sockets were comfortable and gave rise to only a slight mucoid discharge (Fig. 2, opposite). The shape of the sockets made eversion of the upper tarsal plate difficult, but there was no entropion and, having declined prostheses, he preferred to wear dark glasses. For 4 months before the inoculation there had been no inflammation of either socket and he had used only sodium bicarbonate lotion twice daily. He continued to use this throughout the experiment to remove any discharge.

Clinical Course (Table II).—After inoculation of his left socket on March 11, 1958 (D 0), the man was seen next on day seven (D 7) when he complained of soreness of the left socket which had begun on D 2. The right socket appeared unchanged and remained so, except for slight hyperaemia

FIG. 2.—Experiment I, left socket before inoculation (D 0).

TABLE II

EXPERIMENT I: SUMMARY OF CLINICAL COURSE

Day after Inoculation	Discomfort	Discharge	Injection	Oedema	Diffuse Infiltration	Papillary Hypertrophy	Follicles	Cicatrization	Adenopathy
D 2	+++	++							
D 7	++	+++	++++	++++	+++				
D 10	+	+++	++++	++++	+++	++			
D 14	+	+++	++++	++++	+++	++			
D 17	+	++++	++++	+++	++++	++	+		
D 21	+	++++	++++	+++	++++	+++	++		++
D 28		++++	++++	++	++++	+++	++		+
D 35		++++	++++	++	++++		++		+
D 42		+++	++++		++++		+++		
D 49		+++	+++		++++	++++	+++		
D 91		++	+++		++++	++++	++++		
	Biopsy D 98 ++								
D 105		+++	++++	++	++++	++++	++++	++	
D 119		++	+++		+++	++++	++++	++	
D 141		++	++		+++	+++	++++	++	
	Biopsy D 141 ++								
D161		++	++		+++	+++	++++	++	
D188		++	++		+++	+++	++++	++	

\+ minimal
++ slight
+++ marked
++++ very marked

and stickiness which developed after a conjunctival scraping on D 14 and resolved by D 17, whereafter it remained normal until mild changes appeared on D 141.

On D 7 the left socket had a fairly profuse mucopurulent discharge and the entire conjunctiva was intensely congested and oedematous (Fig. 3). The "bulbar" conjunctiva and plica showed a gelatinous oedema, and the conjunctiva of the tarsi and fornices was opaque and diffusely infiltrated. The pre-auricular nodes were not palpable. The soreness of the left socket had diminished by D 10. By D 14 there was intense papillary hyperplasia of the tarsal conjunctiva and a further increase in the diffuse infiltration. The mucopurulent discharge increased and on D 17, amid the general congestion and papillary hypertrophy, pale avascular foci were visible with the slit lamp. These were most marked in the lower lid and in the upper fornix, but were present also on the upper tarsal plate. By D 21 these foci had enlarged to form follicles giving an appearance of granularity which was visible to the naked eye. The upper tarsal plate showed increasing papillary hypertrophy. The left pre-auricular node was palpable and slightly tender.

FIG. 3.—Experiment I, D 7, intense oedema and injection of the conjunctiva with mucopurulent discharge.

Examinations on D 28, 35, 42, and 49 showed a continuing mucopurulent discharge. The conjunctival injection became paler as increasing diffuse follicular infiltration obscured the congested blood vessels and the oedema subsided. The tarsal and retrotarsal conjunctiva became more frankly granular (Fig. 4, opposite). Discomfort diminished whilst the pre-auricular node lost its tenderness (D 28) and became impalpable (D 42).

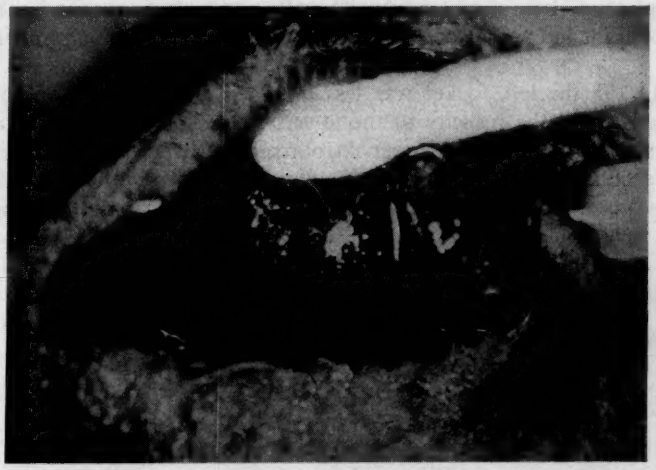

FIG. 4.—Experiment I, D 49, development of follicles on the upper lid.

During the third month (D 91) the conjunctiva slowly became less inflamed and less oedematous. Tarsal papillary hypertrophy persisted, follicles (some with a faintly yellowish tinge) continued to develop, especially in the upper and lower fornices, but also on the plica and on what had formerly been bulbar conjunctiva.

On D 98 under topical anaesthesia with cocaine 4 per cent. and adrenalin 1/1,000, a biopsy was taken from the left lower fornix. Streptomycin drops were given for use three times a day for one week. On D 105 the more acute signs of inflammation recurred. Follicles were more marked on the upper lid and some fine linear and stellate scars could be seen with the slit lamp in the lower fornix, lateral to the site of the biopsy.

In the fourth month (D 119) the discharge decreased and the whole condition assumed a less florid and more chronic appearance. The upper tarsal area continued to show chiefly papillary hypertrophy, but the follicles in the upper fornix became very large and extremely friable.

During the fifth month (D 141) the conjunctiva of the right socket became less transparent and showed a slight diffuse infiltration in the lower tarsal and retrotarsal conjunctiva; the small follicles which had been present in the lower fornix enlarged. On D 161 the right socket had not altered materially. On D 188 the conjunctiva of the right lower fornix and lid still showed slight diffuse infiltration with a few small follicles in the fornix. The appearance of the right socket on D 141 suggested that infection had been transferred from the left socket, but the minimal development observed on D 161 and D 188 made this interpretation doubtful.

Under topical anaesthesia further biopsies were taken on D 141 from the left upper and lower fornices and from the upper border of the left upper

tarsal plate. The follicles ruptured with extreme ease. On D 161 the changes in the left socket continued to assume an even more chronic appearance.

On D 188 the left socket was less inflamed, and the thickening of the conjunctiva and the follicles in the lower lid and fornix were diminishing, whereas the follicles in the upper retrotarsal area were larger, some with a yellowish tinge (Fig. 5). The biopsy sites had healed with small scars and there had been only a slight increase in the number of small linear cicatrices among the follicles.

On D 219 the left conjunctiva showed a reduced amount of injection; the follicles were fewer and less florid and there were more stellate cicatrices.

FIG. 5.—Experiment I, D 188, artist's drawing of the inner end of left upper lid, showing tarsal papillary hypertrophy and two very large follicles at the border of the tarsal plate.

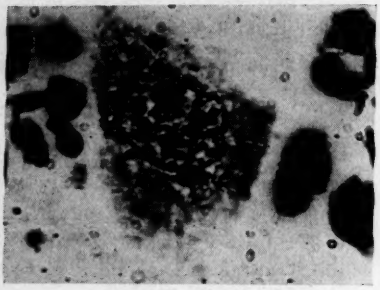

FIG. 6.—Experiment I, D 10, conjunctival scraping from left socket, showing two basophilic initial bodies in the cytoplasm of an epithelial cell. Stained Giemsa–May-Grünwald. ×1,010.

Laboratory Investigations

Cytology of Conjunctival Scrapings.—During the month following inoculation the epithelial cells of the left socket showed marked degenerative changes, with vacuolation of the nuclei and cytoplasm. After this time they became comparatively normal in appearance although cell debris was always present. The exudate consisted of polymorphs, lymphocytes, plasma cells, and large mononuclear cells; relatively greater numbers of polymorphs were present during the first 3 weeks (Table III, opposite).

Scrapings from the right socket showed normal epithelial cells, with moderate numbers of polymorphs. Occasional lymphocytes were found, and on two occasions (D 133 and D 160) scanty plasma cells were seen. These findings are in accordance with the presence of a low-grade inflammation such as is commonly present in a socket owing to the loss of the normal cleansing circulation of tears.

Inclusions.—On D 7 and 14, numerous particles, staining red with Giemsa, were seen lying free or sometimes within the cytoplasm of epithelial cells. These particles resembled elementary bodies in size and in staining characteristics. They were rarely observed after the 14th day. Initial body forms were found more

frequently during the early stages, (Fig. 6) and were particularly numerous on D 14 and D 17 .

TABLE III

EXPERIMENT I: SUMMARY OF INVESTIGATIONS DONE ON CONJUNCTIVAL SCRAPINGS FROM LEFT CONJUNCTIVA

Day after Inoculation	Inclusions	Virus Isolation in Eggs	Cytology			
			Polymorphonuclear leucocytes	Lymphocytes	Plasma cells	Mononuclear leucocytes
D 7	+	Not attempted	++++	+++	++	+++
D 10	++	Negative	++++	++	++	++
D 14	++	Positive	++++	+++	++	++
D 17	+++	Eggs contaminated	++++	+++	+++	+++
D 21	+++	Eggs contaminated	++++	+++	++	++
D 28	++	Positive	++	+	+	+
D 35	+++	Negative	+++	+++	+	++
D 42	—	Positive	++++	++	+	++
D 49	+	Negative	+++	++	++	++
D 65	Not examined	Positive	Not examined			
D 77	++	Positive	++	++	+	+
D 91	+	Positive	++	+++	+	+
D 105	++	Positive	++++	++	+	+
D 119	+	Eggs contaminated	++	+++	+	++
D 133	+	Eggs contaminated	++++	++	++	+++
D 141	+	Positive	++++	+++	++	++
D 161	++	Eggs contaminated	++	+++	++	++

\+ very scanty
++ moderate number
+++ numerous
++++ very numerous

Scanty but typical Halberstaedter–Prowazek bodies were observed on D 7, and then became more numerous (Fig. 7, overleaf). From D 17 to D 35 there were often several visible in single-high-power fields, and they were found at every subsequent examination except one, although tending to diminish in number during the latter part of the experiment (Table III).

The inclusion bodies were typical of those seen in natural trachoma, and the presence of a carbohydrate matrix was repeatedly demonstrated by iodine staining (Fig. 8, overleaf).

Inclusions were never found in scrapings from the right socket.

Histology.—On two occasions, conjunctival biopsies were taken. Sections were stained with haematoxylin and eosin, Giemsa, and Masson's stain. In thin Giemsa stained sections, cytoplasmic inclusions were readily demonstrated in the epithelial cells of both these specimens. The histological findings were as follows:

Conjunctival biopsy (D 98.).—"Many of the conjunctival epithelial cells show degenerative changes in the nucleus and cytoplasm. Occasionally, polymorphonuclear

FIG. 7.—Same field as Fig. 8 after decolorization and restaining with Giemsa–May–Grünwald.

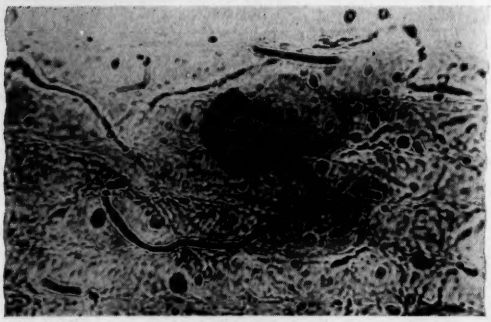

FIG. 8.—Experiment I, D 105, Halberstaedter–Prowazek body in conjunctival scraping. Stained with iodine to show carbohydrate matrix. ×800.

leucocytes and plasma cells have penetrated the epithelial layer. Immediately under the epithelium there is an area of dense infiltration consisting mostly of plasma cells, but showing also polymorphonuclear cells, lymphocytes, and macrophages. Below this area is a well-defined follicle with a central mass of pale-staining cells showing many mitoses, and a peripheral zone of lymphocytes and plasma cells in which the lymphocytes predominate."

Conjunctival Biopsy (D 140) (Prof. N. Ashton, Institute of Ophthalmology).—"Sections show two small fragments of tissue in which the histological changes are essentially the same. Immediately beneath the atrophic conjunctival epithelium there is a dense chronic inflammatory infiltration in which plasma cells predominate and in which much nuclear debris is present. In the larger segment there is a well-defined follicle consisting centrally of large pale mononuclear cells in active mitosis, and peripherally of lymphocytes and plasma cells (Figs 9 and 10, opposite). There is a mild degree of fibrosis in the adjacent stroma but not within the infiltrations."

Serology.—Complement-fixation tests were made on sera taken just before inoculation, and on D 14, 21, and 42. The results were surprising (Table IV, opposite). Before inoculation, the serum titre against the Chinese strain of trachoma virus was 1/32, and a titre of 1/64 was obtained with the G1 strain used for inoculation and with the psittacosis-lymphogranuloma group antigen; 2 weeks after inoculation the same values were obtained, but at 3 and 6 weeks after inoculation the titres had increased to 1/128 with all three antigens.

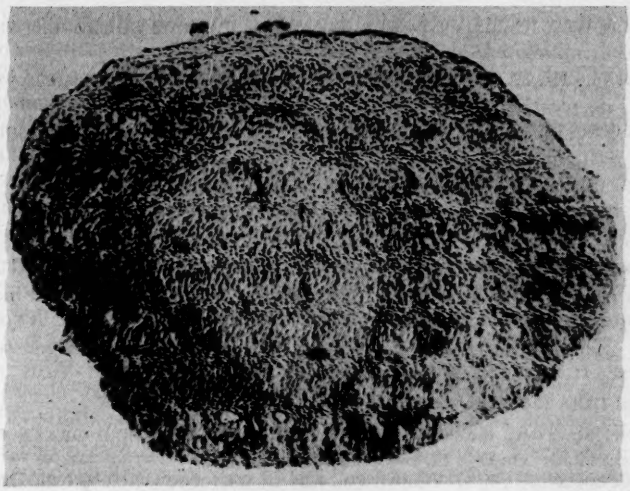

FIG. 9.—Experiment I, D 98, conjunctival biopsy, showing low-power view of follicle with well defined central area of pale-staining cells and denser peripheral zone of lymphocytes and plasma cells. Stained haematoxylin and eosin. ×75.

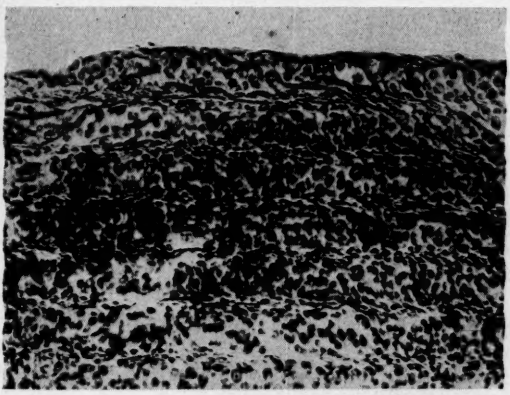

FIG. 10.—Experiment I, D 98, conjunctival biopsy, showing intense subepithelial infiltration by plasma cells, lymphocytes, and macrophages. Stained haematoxylin and eosin. ×180.

TABLE IV

EXPERIMENT I : COMPLEMENT-FIXATION TESTS ON SERA OF HUMAN SUBJECT

Antigen		Serum Titre			
		Before Inoculation	After Inoculation		
			D 14	D 21	D 42
Trachoma Virus	Strain G1	1/64	1/64	1/128	1/128
	T'ang's Strain TE 55 ..	1/32	1/32	1/128	1/128
Psittacosis Antigen		1/64	1/64	1/128	1/128
Normal Yolk-sac Control		<1/4	<1/4	1/4	<1/4

In view of these results, the possibility of a past infection with another virus of the psittacosis-lymphogranuloma group was considered, although there was no history suggestive of such an episode. On D 119 the subject was Frei-tested; 48 hrs later there was no reaction to the control antigen, but an erythematous papule 10 × 11 mm. had developed at the site of injection of the test antigen. This result strongly suggests past infection with a lymphogranuloma virus. It is most unlikely to have been due to the experimental trachoma infection, since we have found in Gambia that children suffering from natural trachoma are consistently Frei-negative.

Virus Isolation.—During the course of the experiment, repeated attempts were made to isolate virus from both right and left sockets by yolk-sac inoculation. The results are given in Table III. Virus was first obtained from the left socket 2 weeks after the start of the experiment and was isolated on seven subsequent occasions. It was still present 20 weeks after inoculation. Virus was never recovered from the right socket.

Bacteriology.—At intervals, cultures were made from both sockets on aerobic blood agar plates. On D 7, 17, and 21, growths of *Corynebacterium xerosis* were obtained from both sockets. On D 17, two colonies of micrococci were grown from the left socket.

Haematology.—The results of blood counts and erythrocyte sedimentation rate determinations have been previously reported (Collier and Sowa, 1958). No gross variations from normal values were observed.

Experiment II

The second volunteer was a man aged 42 years, who was blind from bilateral congenital optic atrophy. He had no external ocular disease but any examination induced extreme reflex blepharospasm and upward deviation of the globes.

Clinical Course (Table V, opposite).—On March 14, 1958 (D 0), the left eye was inoculated.

The patient was next seen on D 7, when he reported slight irritation in both eyes. Examinations of both eyes on D 7, 11, and 14, showed no pathological changes apart from slight conjunctival hyperaemia in the lateral third of each lid of the left eye. The right eye remained unchanged throughout the experiment.

On D 25 the left eye was uncomfortable and watery, and the palpebral conjunctiva injected and thickened. Several small follicles had developed at the outer end of both lids, especially the lower. The left pre-auricular node was palpable and slightly tender.

On D 39 the palpebral conjunctiva was more congested, the lower tarsal conjunctiva was finely granular to the naked eye, and one of the follicles at the outer angle had become moderately large. There was a diffuse roughening of the epithelium on the upper third of the cornea and three small epithelial filaments were present. The eye continued to be slightly watery. On D 46 the conjunctiva was unchanged. Two of the corneal filaments

TABLE V
EXPERIMENT II: SUMMARY OF CLINICAL COURSE

Day after Inoculation	Discomfort	Watery Discharge	Injection	Diffuse Infiltration	Follicles	Adeno-pathy	Roughening of Corneal Epithelium	Punctate Keratitis
D 7	+							
D 11			+					
D 14			+					
D 25	+	+	+	+	+	+		
D 39		+	++	+	++		+	+
D 62		+	+	+	+			+
D 69								

\+ minimal
++ slight
+++ marked
++++ very marked

had desquamated. A punctate epithelial keratitis had developed in the area which had previously shown a diffuse roughening. These lesions were of two types. The first consisted of small groups of fine opaque white dots in the epithelium which stained with bengal rose but not with fluorescein. The second consisted of minute depressions in the epithelium, which stained with fluorescein but not with bengal rose (Fig. 11).

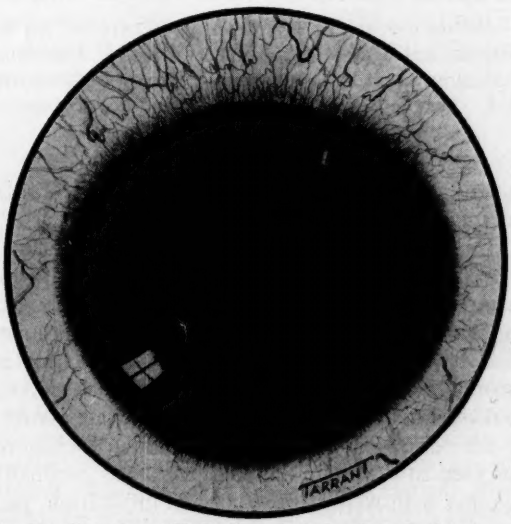

FIG. 11.—Experiment II, D 46, artist's drawing of left cornea, showing punctate epithelial and subepithelial keratitis, one epithelial filament, and congestion of the limbus.

Under some of these lesions there was a faint haze in the superficial stroma. The limbal vessels were congested but no pannus had developed. At this

stage the clinical appearance of the cornea resembled that of a punctate keratitis of viral origin.

On D 62 the congestion and infiltration of the palpebral conjunctiva had lessened and the follicles had begun to regress. The corneal surface was less rough and the punctate lesions were resolving. The limbus was less congested but one minute cellular subconjunctival infiltration, about 1 mm. in diameter, was present at the limbus at 1 o'clock.

By D 69 the left eye and conjunctiva were again normal.

Laboratory Investigations

Conjunctival Scrapings.—These were made at intervals up to and including D 46. Scrapings from the left (inoculated) eye showed epithelial cells and a few polymorphs. On D 11 and D 32 moderate numbers of lymphocytes were seen but plasma cells and large mononuclear cells were absent; on no occasion was the cytology typical of trachoma or inclusions found. Scrapings from the right eye showed epithelial cells and occasional polymorphs.

Virus Isolation.—Attempts to isolate virus from the left eye were made on D 25, 32, 39, 47 with negative results.

Bacteriology.—Cultures made from both eyes on D 11 yielded scanty growths of coagulase-negative *Staph. albus*; a few colonies of *Corynebacterium xerosis* were grown from the left eye.

Serology.—Before inoculation serum antibody titres of 1/4 were obtained by complement-fixation test against the Chinese strain of trachoma virus and the psittacosis-lymphogranuloma group antigen. The serum titre with the G1 strain was less than 1/4. Serum collected on D 39 showed no increase in these values.

Discussion

Although pannus has not been induced by experimental inoculation, the results of Experiment I proved good evidence that the virus we have designated as G1 is aetiologically related to trachoma. The mucopurulent papillary and follicular conjunctivitis of acute onset with mild pre-auricular adenitis running a chronic course to produce early cicatrization, the histological appearances, and the cytology of the conjunctival scrapings, were all typical of the findings in natural trachoma and in experimental trachoma transmitted directly from trachomatous eyes (see Tsutsui, 1958, and others). The inclusion bodies in which a carbohydrate matrix was repeatedly demonstrated are found only in trachoma and in inclusion blennorrhoea. Since the virus used to inoculate the volunteers was originally isolated from a case of trachoma with well-marked corneal infiltration, pannus, and cicatricial changes, the possibility that the G1 strain is a virus responsible for inclusion blennorrhoea can be eliminated. The absence of bacterial conjunctival pathogens and the repeated re-isolation of the virus from the experimental infection amply confirm the presence of the agent at the site of the disease.

The clinical course in Experiment II is difficult to interpret. The mild acute follicular conjunctivitis with pre-auricular adenitis associated with a diffuse roughening of the upper corneal epithelium, leading to a punctate epithelial and subepithelial keratitis, is suggestive of a mild trachomatous infection. The development of corneal filaments, the rapid resolution, the absence of mucopus, and especially the atypical cytology make this interpretation uncertain. The negative virological investigations do not suggest trachomatous infection. These equivocal results may possibly be explained by the comparatively low infectivity of the inoculum, as measured by egg titration. Since the virus is rather labile, it was not desirable to store the inoculum until the results of the infectivity titration were known. The material used was held for a longer period at $-35°$ C. than in Experiment I; although stained smears showed numerous elementary bodies, a significant amount of inactivation may have occurred during storage. On the other hand, the poor titration result may in part be explained by the use of rather older chick embryos than is customary for this work.

The serological findings in Experiment I deserve comment. Whatever the cause might have been for the abnormal level of complement-fixing antibody existing before inoculation, it is apparent that the subject was not protected against the experimental infection. The presence of neutralizing antibody could not be determined, since no test for this is at present available owing to the erratic behaviour of the virus in eggs. The small rise in complement-fixing antibody during the course of the experimental infection accords with what is known to occur in the natural disease.

Addendum

The report of a third case may—or may not—be of interest.

A woman, aged 56, who had previously had both eyes removed for the painful sequelae of iridocyclitis, was admitted to St. George's Hospital, London; clinically both sockets were normal; bacteriologically they showed a scanty growth of coagulase-negative *Staph. albus* and some diphtheroids. As with the two cases previously reported, the left tarsal conjunctiva was inoculated with yolk-sac suspension infected with the G1 trachoma virus previously used, and the right with normal yolk-sac suspension. Two days later both tarsal conjunctivae showed a marked papillary hypertrophy with some discharge, the changes being more marked on the right side than the left. Three days later, three small follicles appeared on the conjunctiva near the proximal margin of the left upper tarsal plate near the lateral canthus. Meantime, the injection of the right tarsal plate was subsiding and no follicles were present. The next day (6 days after inoculation), after the removal of a tooth, the patient was (inadvertently) given 800,000 units penicillin intramuscularly, and 2 days later the follicles had disappeared; the conjunctivae remained normal in clinical appearance during the following 3 weeks. Conjunctival scrapings were examined 2, 5, and 9 days after inoculation. Material from both inoculated and control sockets showed normal epithelial cells, with moderate numbers of polymorph leucocytes and scanty lymphocytes. The cytology was not

typical of trachoma and inclusions were not found. Attempts to isolate the virus from the conjunctival sac on the 14th and 21st days proved negative.

There is little doubt that from the clinical point of view the follicles resembled those of trachoma, although the presence of this disease was not confirmed cytologically or virologically. If this infection had begun to establish itself, the rapid disappearance of clinical signs after the systemic administration of penicillin may be of interest in view of the findings recorded in the subsequent paper (Smith, 1958). The evidence, however, is inferential and inconclusive and is merely reported at this stage in the investigation because it may eventually prove to be of confirmatory value to further observations.

SUMMARY

A case is described of the experimental inoculation of a human volunteer with a virus isolated from a trachomatous patient and subjected to serial passage in the laboratory. The typical clinical and histological picture of trachoma resulted, with the development of inclusion bodies, and the virus was again recovered from the conjunctiva. The evidence that this virus is the causative agent in trachoma is therefore strong.

In view of their possible interest in further investigations, two other inoculation experiments of a less conclusive nature are also described.

The expenses of this research were met in part by grants from the Colonial Development and Welfare Fund. The electron-micrograph was made by Dr. R. Valentine of the National Institute of Medical Research.

Our greatest debt, of course, is to those who volunteered as subjects for inoculation; the observations took much of their time and were potentially capable of causing anxiety and inconvenience to themselves and their families. The first volunteer was a particularly delightful old patient of Moorfields Hospital; the second is an international correspondent at the Royal National Institute for the Blind, London; the third, who had courageously fought a losing battle for her sight for 20 years, was equally willing to put herself at our disposal in the interests of science.

REFERENCES

BELYAVIN, G. (1953). *J. Hyg.*, **51**, 492.
COLLIER, L. H., and SOWA, J. (1958). *Lancet*, **1**, 993.
FULTON, E., and DUMBELL, K. R. (1949). *J. gen. Microbiol.*, **3**, 97.
SMITH, C. H. (1958). *Brit. J. Ophthal.*, **42**, 721.
———, GILKES, M. J., and SOWA, J. (1958). *Ibid.*, **42**, 461.
T'ANG, F.-F., CHANG, H.-L., HUANG, Y.-T. and WANG, K. C. (1957). *Chin. med. J.*, **75**, 429.
TSUTSUI, J. (1958). *Amer. J. Ophthal.*, **45**, 44.

Brit. J. Ophthal. (1958) **42**, 721.

ACCIDENTAL LABORATORY INFECTION WITH TRACHOMA*

BY

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THE isolation of stable strains of trachoma virus reported by T'ang, Chang, Huang, and Wang (1957) and confirmed by Collier and Sowa (1958) has made possible the study of the early stages of this infection. Collier, Duke-Elder, and Jones (1958) have reported studies on blind volunteers and the following account of an accidental laboratory infection is reported as confirmatory evidence that the viruses isolated are indeed the cause of trachoma.

Clinical Course

29.5.58.—When the yolk sacs of chick embryos were being inoculated with T'ang's trachoma strain 55, the needle was accidentally blown off the syringe and a spurt of infected yolk-sac emulsion hit the operator in the face—no direct contamination of the conjunctiva was noticed. The infectious material was washed off with an antiseptic and the face was washed with soap and water, but no special toilet of the conjunctiva was attempted.

4.6.58.—The lid of the left eye began to feel heavy and there was some irritation at the inner canthus. In view of the history of the accident 5 days before, a full virological investigation was undertaken; bacterial and viral cultures were taken and smears and scrapings made.

5.6.58.—By the next day a marked conjunctivitis had developed, worse beneath the upper lid; the eye was painful and distinctly sore to touch, the lids were oedematous, and there was a slight ptosis. Further smears were taken and treatment was commenced with 1 per cent. aureomycin ointment.

No enlargement of the pre-auricular gland was observed.

6.6.58.—There was now definite involvement of the right eye with symptoms similar to those observed in the left eye. The conjunctivitis was still of an indefinite clinical type and there was no corneal involvement.

On this date further scrapings and material for virus isolation were taken by Dr. L. H. Collier.

Systemic treatment was begun with Achromycin 0·5 g. three times daily as a supplement to local aureomycin.

11.6.58.—Subjective improvement was noted although the eyes were still red and oedema persisted. Follicles had now developed in both fornices and a single limbal follicle could be seen at the 2 o'clock position in the left eye.

Achromycin was discontinued, procaine penicillin 300,000 units daily was begun, and local aureomycin was continued.

14.6.58.—The eyes were much improved and the follicles were resolving. Penicillin was discontinued.

18.6.58.—Only slight redness remained.

10.7.58.—Slit-lamp examination of the conjunctiva showed a few residual follicles.

Virus Investigations

Bacterial cultures taken on 4.6.58 were sterile.

* Received for publication August 6, 1958.

Left Eye (scrapings of 4.6.58).—Material from the left eye showed the typical cytological appearance of a trachoma infection with pus cells, lymphocytes, plasma cells, and large phagocytic mononuclear cells. A single inclusion was found in the Giemsa-stained film and an inclusion was also found in a smear stained with iodine.

Material taken on the same day was inoculated into the yolk sac of two 7-day-old chick embryos; 6 days after inoculation one of the two embryos was dead and smears from the yolk sac stained with Giemsa and Castaneda stains showed typical viral inclusion bodies.

Right Eye.—Material from the right eye was investigated by Dr. L. H. Collier, who was able to demonstrate a single inclusion in the Giemsa-stained smear and was also able to isolate the virus by yolk-sac inoculation.

Discussion

Several points of interest arise from this infection. It was unexpected that symptoms would appear so rapidly, as it is usually assumed that the incubation period of trachoma is 10 to 14 days, but this may be due to the dose that infected the conjunctiva. In a case-to-case transmission it is unlikely that the infective dose would be so large. The non-specific nature of the clinical picture is also worth noticing, as it means that in the acute stage when the patient may well be at his most infectious the clinical picture is not that generally recognized as trachoma. This had previously been noted by the author and Gilkes in their investigations in Jordan (Smith and Gilkes, 1956).

The marked clinical improvement that coincided with the start of penicillin treatment is also noteworthy. This might possibly have been the delayed result of tetracycline therapy, but the abrupt subjective improvement makes this unlikely.

Finally it is important that the virus appears to remain fully virulent after many egg passages. This strain had passed through 23 eggs, receiving a dilution of at least 10^{-2} at each inoculation. It had also been freeze-dried and transported from China to England.

Summary

A case of accidental infection with trachoma virus is reported, with subsequent re-isolation of the virus in eggs.

I am indebted to Dr. T'ang Fei-Fan and Dr. L. H. Collier who originally made the virus strain available to me, and to Mr. Evans and Mr. Barrie Jones for their clinical observations.

REFERENCES

COLLIER, L. H., DUKE-ELDER, S., and JONES, B. R. (1958). *Brit. J. Ophthal.*, **42**, 705.
—— and SOWA, J. (1958). *Lancet*, **1**, 993.
SMITH, C. H., and GILKES, M. J. (1956). *Unpublished observations.*
T'ANG, F.-F., CHANG, H.-L., HUANG, Y.-T., and WANG, K. C. (1957). *Chinese med. J.*, **75**, 429.

Brit. J. Ophthal. (1958) **42**, 723.

CATARACT EXTRACTION UNDER GENERAL ANAESTHESIA*

A CONSIDERATION OF 100 CASES

BY

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IT seemed worthwhile confirming the work of Cridland (1955) who recorded a series of cataract extractions under general anaesthesia at a time when this method was used only by a minority.

General anaesthesia for all ophthalmic surgery has come to stay. It would not be right to be dogmatic as more work needs to be done but, provided the patient is in satisfactory health, it merits serious consideration for all major intra-ocular operations. There is little need to reiterate the advantages, but the most important one is that the average surgeon will be a better performer and obtain better and more uniform results if he has no longer to contend with the reactions of the patient during operation.

Skilled anaesthesia is, of course, essential, and we are fortunate that this is readily available in Great Britain. The majority of the cases in this series were handled by anaesthetists of registrar status using standard technique. It will be noted that an endotracheal tube was passed in all cases, and this is in agreement with the opinion of Sandiford (1955, 1957) as it gives the anaesthetist a much higher degree of control than the pharyngeal tube used by Harper (1956). Neither ether nor chloroform was used in any concentration, but at one hospital fluothane was used in a few cases with satisfactory results.

There were, of course, small differences of procedure between the anaesthetists who gave their advice so freely, but an average routine is given in detail.

Procedure

The patient is admitted 2 days before operation. Chloral hydrate 15 gr. is given on the first night, and on the second night Phenergan 25 mg. is given by mouth to sedate and prevent or relieve bronchospasm and possibly to reduce post-operative vomiting.

Premedication is by atropine 1/100 gr. and pethidine 50 mg. by injection one hour pre-operatively.

Induction is by a sleeping dose of 2·5 per cent. thiopentone followed by suxamethonium 50 mg. given through a Mitchell needle.

The vocal cords are sprayed with 5 per cent. Xylocaine and an endotracheal tube greased with 2 per cent. Xylocaine ointment is inserted. The anaesthetic is maintained on nitrous oxide and oxygen 6 litres to 2 litres, and intermittent small doses of pethidine are injected as required.

* *Received for publication January 1, 1958.*

At the conclusion of the operation, pharyngeal toilet is performed as necessary, the endotracheal tube is removed, and a pharyngeal tube is inserted when the patient's reflexes will tolerate this.

The patient is usually awake on return to the ward and is encouraged to sit up and do deep breathing exercises. Coughing and vomiting are minimal.

Chloral hydrate 15 gr. is given the same night.

Corneo-scleral sutures are now probably used by most surgeons. They are even more essential under general anaesthesia and a word on their use may not be out of place.

There must be an increased risk, however slight, of coughing and vomiting after general anaesthesia, but there need not be the slightest anxiety if the wound is adequately sutured. It is useful to have one pre-placed groove suture as this can be drawn tight at any stage and it can be used to raise the cornea for intra-ocular procedures. Two additional post-placed sutures are used as a routine, and if the wound shows any sign of inaccurate apposition as many as four more can be inserted with advantage.

The introduction of air into the anterior chamber is now a routine procedure and if the air shows any sign of escaping it is a firm indication that more sutures are required.

The removal of sutures is often an anxious procedure; early removal is not necessary unless the sutures are causing gross irritation and then I would not hesitate in requesting a second general anaesthetic. The majority can be left to cut out spontaneously; this usually occurs after about 4 weeks when the remainder can be removed easily as the wound is well healed.

Results

These are no more spectacular than any other average series of cases (Table).

TABLE

RESULTS IN 100 CASES

Particulars		No. of Cases
Visual Acuity	6/6	59
	6/9 to 6/12	16
	Less than 6/60	12
Complications	Iris prolapse	5
	Vitreous loss	2
	Scoop extraction	Nil
	Retinal detachment	1
	Eye lost	2*
Route of Extraction	Intracapsular	46
	Extracapsular	54
	Total	100

* One infection, one gross iris prolapse (self-inflicted).

Complications.—These have occurred and an occasional eye has been lost, but even so general anaesthesia is so comfortable for the patient and the surgeon that it is now the method of choice in these three hospitals.

Iris Prolapse.—This is always a liability. In none of the five cases in which it occurred however, did it appear before the second post-operative day, and therefore it cannot be attributed to the anaesthetic.

Hyphaema was not encountered. This complication has largely disappeared because of the use of corneo-scleral suturing.

Visual Acuity.—A visual acuity of 6/6 was achieved in only about 60 per cent. of cases. This was not due to high astigmatism which averaged only 1·5D, but many patients with apparently perfect results refused to see better than 6/9 although the reading vision was satisfactory and the macula apparently normal. This point was noted by Glover (1954).

There were two complications of a general nature which might be attributed to the anaesthetic. One patient was a misdiagnosed case of myotonia dystrophica and extreme anxiety was caused by failure to maintain spontaneous respiration after operation. This case has been reported elsewhere (Bourke and Zuck, 1957), and emphasizes that a full pre-operative examination must be undertaken if general anaesthesia is to be used. The second patient sustained a minor coronary thrombosis on the fifth post-operative day, but this might have been due to the acceleration of a pending occurrence.

Summary

General anaesthesia is the method of choice for cataract surgery in these three hospitals. It is safe and comfortable for both surgeon and patient. One hundred cases are briefly considered and the technique used given in detail.

My thanks are due to Drs. D. Zuck, P. W. Spencer Gray, and J. S. E. Manley, consultant anaesthetists, and to their registrars, from whose anaesthetic procedures and advice I have quoted freely.

REFERENCES

BOURKE, T. D., and ZUCK, D. (1957). *Brit. J. Anaesth.*, **29**, 35.
CRIDLAND, N. (1955). *Trans. ophthal. Soc. U.K.*, **75**, 563.
GLOVER, E. C. (1954). *Ibid.*, **74**, 145.
HARPER, J. K. (1956). *Brit. J. Ophthal.*, **40**, 661.
SANDIFORD, H. B. C. (1955). *Trans. ophthal. Soc. U.K.*, **75**, 575.
—— (1957). *Brit. J. Anaesth.*, **29**, 319.

ADDENDUM

Since the submission of the above article a further 72 cataracts have been operated upon under general anaesthesia. The results have been uniformly satisfactory. No eye was lost. There was only one iris prolapse and no case of vitreous loss. Hyphaema of more than one millimetre occurred in only one case. When these figures are added to those given above, it may reasonably be concluded that general anaesthesia is satisfactory as far as the eye itself is concerned. The general picture, however, is not quite so certain. One woman aged 73 sustained a coronary thrombosis on the 11th day after operation and died. It is difficult to know to what extent this should be attributed to the anaesthetic as it came without warning, but clearly great care must be taken with frail old people.

Brit. J. Ophthal. (1958) **42**, 726.

ROBERT BOYLE'S "UNCOMMON OBSERVATIONS ABOUT VITIATED SIGHT", (LONDON, 1688)*

BY

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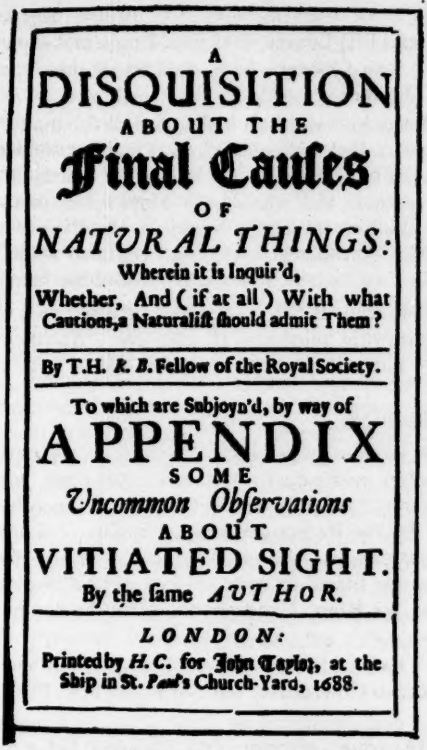
ROBERT BOYLE (1627–1691) is known to every schoolboy for his discovery of the law of gaseous elasticity, "Boyle's law". He was one of the foremost "experimental natural philosophers" of his time, an original fellow of the Royal Society of London and author of many works dealing with physics, chemistry, physiology, theology, etc. Not so well known perhaps is that he was created Doctor of Medicine of Oxford University in 1665 (Foster, 1891) and that scattered throughout his scientific writings are many discussions of medical subjects often based on his own astute clinical observations. Among these are several records of patients with visual disturbances and eye diseases, a subject in which he had a particular interest, as shown for example by his researches into the physics of light and the physiology of vision in *Experiments and Considerations Touching Colours* (1664). This interest doubtless derived from his hypochondriacal concern when a youth about "a sense of decay in my Eyes" (Boyle, 1693), for which he consulted the great William Harvey (Boyle, 1663). For the rest of his life this "weakness made him very tender of them, and extremely apprehensive of such distempers as might affect them" (Birch, 1744).

Three years before his death he gathered together a number of the more unusual ophthalmological cases he had seen under the title "Some Uncommon Observations about Vitiated Sight", and appended them as a separate tract to *A Disquisition about the Final Causes of Natural Things* (1688):

"Because that, the Eyes being those Parts of the Bodies of Men and other Animals, that I pitch'd upon in the Foregoing Treatise, to Strengthen the Doctrine deliver'd in it about Final Causes; it seem'd Suitable Enough to my Subject and Design, to mention some Uncommon Things that related to Vision or the Organs of it, that We may be invited *both* to Admire the Wisdom of God, which, to furnish Man with a Sense that requires the Concourse of so very many things, has, if I may so speak, Crowded them into so Small an Engine as an Eye; *and* to Celebrate his Goodness too, which has been Display'd in that, notwithstanding that the Eye is so very Compounded a Part, and the Sight so easily Vitiated yet the most part of Men by far do, from their Cradles to their Graves, enjoy the Benefit and Comfort of so Necessary and Noble a Sense" ([242–244]).

This tract appears to have remained unnoticed by historians of ophthalmology,

* Received for publication, January 1, 1958.



A
DISQUISITION
ABOUT THE
Final Causes
OF
NATURAL THINGS:
Wherein it is Inquir'd,
Whether, And (if at all) With what
Cautions, a Naturalist should admit Them?

By T.H. *R. B.* Fellow of the Royal Society.

To which are Subjoyn'd, by way of
APPENDIX
SOME
Uncommon Observations
ABOUT
VITIATED SIGHT.
By the same *AUTHOR.*

LONDON:
Printed by *H. C.* for John Taylor, at the
Ship in St. *Paul's* Church-Yard, 1688.

FIGURE.—Title page of one of the two issues of *A Disquisition about the Final Causes of Natural Things* by The Honourable Robert Boyle (T.H., *R.B.*). (Fulton, No. 186, 186A.)

e.g. Hirschberg (1899–1918), James (1933), and Sorsby (1948). Fulton (1932), in his *Bibliography of the Honourable Robert Boyle*, considered that it was "one of the first in which this method of teaching [by demonstrating case histories] was employed in an ophthalmological treatise".

There are fourteen observations in all, each with a commentary by Boyle:

Observation 1.—A man with post-traumatic progressive blindness, who had lost colour vision but could distinguish white objects.

Obervation 2.—A healthy young man with post-traumatic cataract over the upper half of the pupil; his visual acuity was diminished but he could still discern white objects.

Observation 3.—A man with bilateral cataracts which had been badly extracted leaving him with synechiae, who was nevertheless still able to read in the dark "with the help of his *Cataract Spectacles*".

Observation 4.—A man with two distinct cataracts in the upper part of one eye following trauma, "Two Cataracts at a time in one Eye being some what Extraordinary".

Observation 5.—A man with diplopia for distant objects accompanied by "divers Black Flyes and litle Leaves, that pass'd now and then before his Eyes . . . some Persons, before their Cataract, have complain'd that at some Distances they saw Objects almost Double".

Observation 6.—A woman who had had cataracts for many years (long enough to have been "brought a Bed of Six Children") had her sight restored completely "by having the Cataracts Couched. . . . It may be worth Observing, How long The better sort of Cararacts, tho' they hinder Sight for a time . . . yet may remain in the Eye, without Spoiling the Optic Nerve or Hindring Vision when once the Cataract is remov'd". Another girl was aged eighteen when she had congenital cataracts "so happily Couched, as afterwards to have the benefit of Sight".

Observation 7.—This records the experiences of three men who had difficulty in judging distances following blindness in one eye. Another patient, despite a complete sixth nerve palsy in one eye since the age of two, did not suffer from diplopia.

Observation 8.—See below.

Observation 9.—A woman with bilateral miosis—"which is often esteem'd a good Sign"—saw better in the dark: "In which odd Case, whether the smallness of her Pupils, which might possibly be Contracted too much by the Day-light, and might be Expanded by the Recess of so much Light . . . I shall not now stay to Enquire". Also mentioned is "the rare Case of a Learned old Divine, who complain'd to me that he was forced to write his Letters and Books by Night, because, during the Day-time, his Right Hand shook so much that he could not manage a Pen".

Observation 10.—"Two Ladies of very distant Ages, but very near of Kin", one of whom was "subject to Convulsive, but not Epileptick, Fits", both at times saw "Sparks of Fire".

Observation 11.—A young woman who regained her sight after five years' blindness: "I ask'd the Lady whether she were not troubled with Female Obstructions? to which she Answer'd me, she was not now, but that formerly she had been much subject to them, having been obstinately troubled with the Green-sickness".

Observation 12.—A man with blindness for unspecified colours.

Observation 13.—A woman with attacks of unilateral headache followed by "a Convulsive Motion in One" eye "whereby it would not only be drawn away, but, which was very strange, All White Things, and most other Objects, that she look'd on with that Eye, appear'd Green to her"; she also suffered from diplopia during an attack.

Observation 14.—See below.

Observations 8 and 14 seemed to us of especial interest, and we therefore give them in full.

Observation 8

"It may be worth while to Observe, that a very great Distention may be made of the Parts of the Eye, without Spoiling the Sight; of which I lately saw an Instance in a Patient of that Ingenious and Experienced Oculist, Dr. *Turbervill.* This was a

Gentlewoman about one or two and twenty years of Age, Whose Complexion and Features would have made her Handsom, if she had not had that sort of Eyes, which tho' rarely met with, some call Ox-Eyes; for Hers were swell'd much beyond the size of Human Eyes, in so much, that she complain'd, they often frighted those that saw Her, and were indeed so Big, that she could not move them to the Right Hand or the Left, but was constrain'd to look strait forward; or if she would see an Object that lay Aside, she was oblig'd to turn her Whole Head that way. And so she answer'd me she was, when she set herself to Read in a Book, unless she did with her Hand move the Book from one side to another, to bring the ends of the Lines directly before her Eyes. She told me her Eyes did not always retain the same measure of Tumidness, and that the very day I saw them, they had been in the Morning much more Swell'd than when I look'd upon Her. But that which was more remarkable, was, that not only she could, for all this, See very well and distinctly, and, as I just now intimated, could Read Books, but her Sight had continued good, tho' she had this Distemper these twelve years. And, which is more strange, she answer'd me, that her Visive Power was so little Prejudic'd by this Distemper, when it first came upon her, that she never knew any thing was amiss in her Eyes, till her Friends told her of it, when they found it had continued too long to be a meerly Casual and Transient Tumor. But, tho' this odd Accident did not Impair her Sight, it occasion'd great Pains in her Eyes, for which she took Purging and other Medicines, with so little Success, that both she and her former Physicians, thought her case Desperate; there appearing no way of dislodging a Humour so long settled there. Upon which I propos'd *Salivation*, as the least unlikely way that remain'd to Resolve and carry off the Peccant Humour. But this, tho' much approv'd by her Doctor, the Modest Patient would by no means consent to".

Observation 14

"Some may think that a Man has rather an Excellent, than a Vitiated Sight, who can See Objects with a far less degree of Light than other Men have need of to Discern them. But tho' an Extraordinary Tenderness may be a kind of Perfection in the Eyes of *Bats* and *Owls*, whose usual Food may be more easily Purchased by Twilight: Yet as to Man, the main part of whose Actions is to be perform'd by the Light of the Day, or some other almost Equivalent; it may Argue the provident goodness of the Author of Nature, to have given Him Eyes Constituted as those of Men generally are: Since, That a very great Tenderness of the *Retina*, or principal part of the Organ of Sight, would be, if not an Imperfection, at least a great Inconvenience, may appear by the Memorable Story I am going to Relate.

In the Army of the late King of Hapy Memory, (*Charles* the First) there was a Gentleman of great Courage and good Parts, that was Major to one of the Regiments; who being afterwards by the prevailing Usurpers forc'd to seek his Fortune abroad, ventur'd to do his King a piece of Service at *Madrid*, which was of an Extraordinary Nature and Consequence, and there judg'd very Irregular. Upon this he was committed to an Uncommon Prison, which, tho' otherwise Tolerable enough, had no Window at all belonging to it, but a Hole in the thickness of the Wall, at which the Keeper once or twice a day put in liberal provision of Victuals and Wine, and presently Clos'd the Window, if it may be so call'd, on the Out-side, but not perhaps very Solicitously. For some Weeks this poor Gentleman continu'd in the Dark, very Disconsolate. But afterwards he began to think he saw

some little Glimering of Light, which from time to time Increased; insomuch, that he could not only Discover the Parts of his Bed, and other such large Objects, but at length came to Discover things so Minute, that he could Perceive the Mice that frequented his Chamber, to eat the Crumbs of Bread that fell upon the Ground, and Discern their Motions very well. Several other Effects of his Sight in that Dark Place He Related. And that which Confirms that this Proceeded mainly from the great Tenderness the Visive Organ had acquired, by so long a stay in so Obscure a Place, was, that when after some Months, the Face of Affairs Abroad being somwhat Chang'd, His Liberty was restor'd him, he durst not leave his Prison Abruptly, for fear of losing his Sight by the Dazling Light of the Day; and therefore was fain to Accustom his Eyes by slow degrees to the Light. This Strange, as well as once Famous Story, I the less Scruple to set down in this Place, because I had the Curiosity to learn it from the Gentleman's own Mouth, who acquainted me with other Particulars about it, that, for want of the Notes I then took, I shall not now venture to speak of".

Discussion

Observation 8.—This patient suffered from exophthalmic ophthalmoplegia. Exophthalmos, whether due to enlargement or protuberance of the eye, had been vulgarly known for centuries in this country as "Ox-Eyes" (*cf.* Du Laurens, 1599); Hirschberg (1899) credited Paulus Aeginata (7th century A.D.) with having been the first medical writer to mention the condition. Thyrotoxicosis in association with exophthalmos was first recorded in 1825, in a posthumous edition of Parry's writings and was subsequently fully described by Graves (1835) and Basedow (1840). The term ophthalmoplegia was first introduced by Stoeber in 1834 (Hirschberg, 1912), while, according to Duke-Elder (1952) following Brain and Turnbull (1938), "external ophthalmoplegia in thyrotoxicosis associated with 'malignant' exophthalmos was first described by Naumann (1853) in a case wherein the protruding eyes were immobile".

There is insufficient evidence to conclude that Boyle's patient was suffering from thyrotoxicosis, although perhaps "the Modest Patient" might mean "the nervous patient"; and her refusal to accept his treatment "tho' much approv'd by her Doctor" may have resulted from this. There is no hint of systemic disease: that "both she and her former Physicians, thought her case Desperate" probably means only that they were concerned at the length of time the exophthalmos had persisted unchanged. It is of course possible that she had earlier suffered from thyrotoxicosis which had subsided while the exophthalmos remained.

It is of interest that she was not the only puzzling "Patient of the Ingenious and Experienced Oculist, Dr. *Turbervill*" whom he referred to Boyle for a second opinion. Indeed it seems almost as if his contemporaries considered Boyle something of an authority on obscure conditions of the eye, for Turberville (1684) wrote of another patient whose eye disease he could not

diagnose: "him I carried to Mr. Boyl, as a fit subject for so great a *Philosopher* to make his remarks on".

Observation 14.—In this Boyle gave a comprehensive account of adaptation to dark and light which anticipated Aubert's classical account of 1865 (Duke-Elder, 1932) by almost two hundred years.

Summary

Attention is drawn to some of Robert Boyle's contributions to ophthalmology. These include classical accounts of exophthalmic ophthalmoplegia and adaptation to dark, which preceded by almost two hundred years the writings of those to whom credit for the first description is usually assigned.

REFERENCES

BASEDOW, C. A. VON (1840). *Wschr. ges. Heilk.*, pp. 197 and 220.
BIRCH, T. (1744). "The Life of the Honourable Robert Boyle", *in* "The Works of the Honourable Robert Boyle", vol. 1, p. 86. Millar, London.
BOYLE, R. (1663). "Some Considerations Touching the Usefulnesse of Experimental Natural Philosophy", part 2, p. 72. Davis, Oxford.
——— (1664). "Experiments and Considerations Touching Colours". Herringman, London.
——— (1688). "A Disquisition about the Final Causes of Natural Things", pp. 239–274. Taylor, London.
——— (1693). "Medicinal Experiments", 2nd ed., vol. 2, p. A6a. Smith and Walford, London.
BRAIN, R., and TURNBULL, H. M. (1938). *Quart. J. Med.*, **7** (n.s.), 293.
DUKE-ELDER, S. (1932). "Text-book of Ophthalmology", vol. 1, p. 955. Kimpton, London.
——— (1952). *Ibid.*, vol. 5, p. 5486.
FOSTER, J. (1891). "Alumni Oxonienses", vol. 1, p. 163. Parker, Oxford.
FULTON, J. F. (1932). "A Bibliography of the Honourable Robert Boyle", *Oxford Bibliographical Society Proceedings*, vol. 3, part 1, p. 116. Oxford.
GRAVES, R. J. (1835). *Lond. med. surg. J.* (*Renshaw*), **7**, 516.
HIRSCHBERG, J. (1899–1918). "History of Ophthalmology", *in* "Graefe-Sämisch Handbuch der gesamten Augenheilkunde", 2nd ed., vols 12–15. Engelmann, Leipzig.
——— (1899). *Ibid.*, vol. 12, p. 393.
——— (1912). *Ibid.*, vol. 14, part 3, p. 204.
JAMES, R. R. (1933). "Studies in the History of Ophthalmology in England prior to the Year 1800". University Press, Cambridge.
DU LAURENS, A. (1597). "Discours de la conservation et de l'excellence de la vue". Mettayer, Paris. *Trans.* R. Surphlet (1599) *as* "A Discourse of the Preservation of the Sight", p. 49. Jacson, London.
NAUMANN, M. (1853). *Dtsch. Klin.*, **5**, 269.
PARRY, C. H. (1825). "Collection from the Unpublished Medical Writings of Caleb Hillier Parry", vol. 2, p. 111. Underwood, London.
SORSBY, A. (1948). "A Short History of Ophthalmology", 2nd ed. Staples, London.
TURBERVILLE, D. (1684). *Phil. Trans.*, **14**, 736.

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EFFECT OF DIAMOX ON PLASMA BICARBONATE AND ON THE ELECTROLYTE BALANCE IN RELATION TO INTRA-OCULAR PRESSURE IN MAN*

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THE primary action of Diamox is to inhibit the enzyme carbonic anhydrase, thereby arresting the formation of bicarbonate ions. This occurs in various tissues which contain the enzyme, notably the kidney, red blood cells, gastric mucosa, and uveal tissue. Its inhibitory action is immediate and highly specific (Mann and Keilin, 1940), and it has been questioned whether its effect on intra-ocular pressure is due to its local or its systemic action.

Experimental work on animals has shown that Diamox causes total inhibition of the enzyme in the uveal tissue (Green, Bocher, Calnan, and Leopold, 1955), that it reduces the bicarbonate content of the aqueous (Lee, 1955), that it diminishes the rate of formation of aqueous humour (Langham, 1955), and that it promotes a notable fall in intra-ocular pressure.

It was at first believed that these phenomena affected the secretory processes of the eye as described by Friedenwald (1949), but in an able summary of the evidence Duke-Elder (1957) has shown that this cannot be true. Thus, in rabbits, although the activity of carbonic anhydrase is undoubtedly inhibited in the eye by Diamox, the bicarbonate content of the aqueous is merely diminished and its concentration relative to that of the plasma remains unchanged, both being reduced (Green and others, 1955; Duke-Elder, Perkins and Langham, 1956). In rabbits it has been recorded that, although the carbonic anhydrase may be wholly inhibited in the eye after the intravenous or subconjunctival administration of Diamox, there may be no fall in intra-ocular pressure at all (Green and others, 1955).

Aqueous flow is reduced by some 25 per cent. when Diamox is given systemically (Langham and Lee, 1957), but a similar reduction can be achieved by the administration of ammonium chloride, a substance which like Diamox causes an acidosis, but has no effect on carbonic anhydrase (Langham and Lee, 1955).

The permeability of the blood–aqueous barrier is also unaffected by Diamox as measured by the fluorescein technique (Langham and Lee, 1957), by the transference of radioactive or non-radioactive sodium, and by the rate of transference of ascorbic acid (Langham and Lee, 1955).

The available evidence of what takes place in the human subject, which is sparse owing to the obvious difficulty of obtaining *in vivo* samples of aqueous,

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differs slightly from the findings from animals. Franceschetti, Marty, and Dubler (1956) have reported a slight decrease in the CO_2 content of the aqueous humour after the administration of Diamox, and Becker (1957), in samples taken from human subjects affected with senile cataract after 24 hours' systemic treatment with Diamox, found that the average fall in bicarbonate was much less in the aqueous (21·5 to 19·2 m.mol./kg.) than in the concurrent samples of arterial plasma (25·9 to 20·5 m.mol./kg.).

In a comparative study of the CO_2 content of ocular fluids, Davson and Luck (1956) have shown that a high concentration of bicarbonate is not a general feature of mammalian aqueous humour, and have concluded that "it is unsafe to base a general theory as to the mechanism of formation of this fluid on a single feature of the chemical composition of the rabbit's aqueous humour. Indeed the action of Diamox is most pronounced in the human eye which has a deficiency of bicarbonate".

The observations which we record in this paper concerning bicarbonate of the plasma were made in the course of determining the effect of Diamox on the electrolyte balance of the blood. They provide further evidence that the variations in intra-ocular pressure are not directly associated with the changes in bicarbonate.

Experimental Method

Our experiments, which were confined as formerly (Campbell, Tonks, and Jones, 1956), to the effect of a single dose of 250 mg. Diamox, were made on ten individuals chosen at random from the glaucoma clinic.

These subjects were investigated as in-patients in a resting state, and preliminary records were made for several days of the diurnal variation of intra-ocular pressure and of blood electrolytes. The subjects were maintained on an ordinary hospital diet, with a sodium intake limited to 40–45 mEq. a day, and a state of steady hydration was maintained during the first few hours of the experiment, 140 ml. water being given at hourly intervals 2 hours before and 3 hours after the dose of Diamox. In short, the sodium and fluid intakes were limited so as not to influence the blood changes. Samples of blood were taken by venepuncture, under paraffin.

Methods of Estimation.—In the course of our investigations, the following methods of estimation were used:

Serum sodium	Flame photometer
Serum potassium	Flame photometer
Serum calcium	Kramer and Tisdall (1921)
Serum magnesium	Briggs (1922a)
Serum chloride	Claudius (1922)
Serum phosphorus	Briggs (1922b)
Serum inorganic sulphate	Letonoff and Reinhold (1936)
Serum protein	Wolfson, Cohn, Calvary, and Ichiba (1948)
Serum bicarbonate	Manometric method using the Warburg apparatus
Serum organic acid	Deduced by subtraction

Results

(1) Plasma Bicarbonate.—The concurrent changes in plasma bicarbonate and in intra-ocular pressure in each of the ten subjects are shown in the Table. The bicarbonate fell slowly in the first few hours after the administration of Diamox, and showed comparatively little change during the period of maximum fall in intra-ocular pressure. The pressure returned to its original level within 24 hours, and the usual diurnal variations were resumed in the subsequent days (Fig. 1, overleaf), while the plasma bicarbonate continued to fall.

The figures for individual cases (Fig. 2, overleaf) show that in some cases the plasma bicarbonate did not return to its predosage level for 6 days.

(2) Electrolyte Balance.—The total electrolyte balance was followed in two subjects (9 and 10) before and after the administration of Diamox. Similar results were obtained, Case 9 being affected with open-angle glaucoma with no field loss and no cupping of the optic discs, while Case 10 suffered from narrow-angle glaucoma, bilateral cupping of the discs, and marked loss of visual field in both eyes. The data given in Fig. 3 (overleaf) refer to Case 9. There was an immediate fall in the total cations, mainly because of a fall in sodium, which remained below the initial level for 48 hours. The fall in

TABLE: EFFECT OF DIAMOX ON CO_2 OF PLASMA

Case No.		1			2			3			4		
		CO_2 (mEq/l.)	I.O.P. (mm. Hg) R	I.O.P. (mm. Hg) L	CO_2 (mEq/l.)	I.O.P. (mm. Hg) R	I.O.P. (mm. Hg) L	CO_2 (mEq/l.)	I.O.P. (mm. Hg) R	I.O.P. (mm. Hg) L	CO_2 (mEq/l.)	I.O.P. (mm. Hg) R	I.O.P. (mm. Hg) L
Before Diamox		29·2 26·8	27·8 27·8	36·9 36·9	26·2 26·0 26·9 27·8 28·3	30·8 26·8 26·8 30·8 26·8	30·8 26·8 26·8 30·8 26·8	30·1 31·0 30·6	40·6 35·4	— —	28·1 28·6 30·8 30·0	35·4 30·8 40·6	30·8 26·8 26·8
Immediately before Diamox		29·2	31·8	36·9	28·6	30·8	35·4	31·4	40·6	—	30·1	40·6	30·8
After Diamox	¼ hr				27·7	26·8	26·8	30·3	46·5	—	28·4	35·4	26·8
	1 hr												
	2 hrs												
	3 hrs	26·6	20·2	23·5									
	5 hrs												
	6 hrs	26·2	20·2	23·5				28·6	30·8	—	27·0	35·4	30·8
	7 hrs												
	9 hrs	26·6	20·2	23·5									
	11 hrs	25·8	14·7	23·5									
	24 hrs	24·4	31·8	36·9	24·6	26·8	26·8	27·3	40·6	—	26·0	35·4	30·8
	27 hrs												
	30 hrs												
	48 hrs	25·3	31·8	36·9				29·3	30·8	—	26·2	40·6	30·8
	3 days	28·8	31·8	36·9	26·6	23·2	26·8	29·4	40·6	—	28·2	40·6	30·8
	4 days										28·6	40·6	30·8
	5 days												
	6 days	29·2	31·8	36·9	27·0			31·9	40·6	—			
	7 days							30·6	46·4	—	24·1	35·4	23·2
Type of Glaucoma		Cupped discs Narrow angle			Cupped discs Open angle			Cupped discs Narrow angle			Cupped discs Narrow angle		
Corrected Vision			6/18	6/6		6/6	6/6		6/9	Blind		6/18	6/18

potassium was proportionately greater than that in sodium, but was not sustained.

A similar fall took place in the total anions, mainly because of the fall in chloride and bicarbonate, of which the former contributed 50 per cent. and the latter approximately 20 per cent. during the first 2 hours. At the end of 5 hours the chloride rose in compensation for the continued fall of bicarbonate. Plasma protein did not begin to fall until after this time.

Although the proportionate fall in ions as displayed graphically in Fig. 3 is a little misleading owing to differences in scale, it is evident that sodium and chloride are the ions most affected during the first 6 hours after Diamox, *i.e.* during the fall in intra-ocular pressure, and that the fall in bicarbonate during this time is not significant.

Discussion

Our findings show that there is no direct association between the small reduction in plasma bicarbonate and the immediate fall in intra-ocular pressure which occurs after the administration of Diamox. Moreover the intra-ocular pressure appears to behave independently of a low level of plasma bicarbonate for several days. It is more probable that the ocular effect of the drug is associated with some other aspect of its systemic action, bearing in mind that in continuous therapy the self-limiting effect of Diamox is

AND ON INTRA-OCULAR PRESSURE IN TEN CASES

5			6			7			8			9			10		
CO_2 (mEq/l.)	I.O.P. (mm. Hg)		CO_2 (mEq/l.)	I.O.P. (mm. Hg)		CO_2 (mEq/l.)	I.O.P. (mm. Hg)		CO_2 (mEq/l.)	I.O.P. (mm. Hg)		CO_2 (mEq/l.)	I.O.P. (mm. Hg)		CO_2 (mEq/l.)	I.O.P. (mm. Hg)	
	R	L		R	L		R	L		R	L		R	L		R	L
						30·6	20·2	23·5									
28·5	*31·8*	*27·4*				29·8	20·2	23·5									
27·0	36·9	31·8				29·4	23·5	27·4	31·0	23·5	27·4						
28·5			28·6	14·7	14·7				29·1	27·4	27·4	30·6	20·2	27·4	30·8	46·5	14·7
26·5	36·9	31·8	30·8	12·5	12·5				31·4	27·4	27·4	30·3			29·4	40·6	10·7
28·1	27·4	23·5	30·2	12·5	12·5	31·0	27·4	23·5	30·3	27·4	23·5	31·0	31·8	27·4	31·0	46·5	17·2
												29·7	27·4	23·5	28·5	46·5	17·2
						30·1	27·4	23·5				*29·4*	*27·4*	*23·5*	*31·1*	*40·6*	*12·6*
									30·5	17·3	20·2	29·2	27·4	23·5	31·0	35·4	12·6
												28·4	20·2	20·2	31·1	35·4	14·7
27·2	31·8	20·2	29·3	12·5	12·5	28·3	36·9	20·2	28·6	23·5	23·5						
												26·0	20·2	20·2	28·0	35·4	14·7
24·8	27·4	23·5	28·1	17·3	14·7	27·4	23·5	23·5	27·3	27·4	23·5	27·0	27·4	27·4	27·0	40·6	12·6
									26·2	27·4	27·4						
24·9	31·8	23·5	31·0	14·7	14·7	26·7	20·2	23·5	28·2	27·4	27·4	27·9	27·4	27·4	32·5	46·5	17·3
26·0	31·8	27·4				28·6						28·6					
29·7																	
						29·4						30·8					
Cupped discs Narrow angle			Cupped discs Narrow angle			Normal discs Narrow angle			Cupped discs Narrow angle			Left disc cupped Open angle			Cupped discs Narrow angle		
	6/18	6/24		6/6	6/6		6/9	6/9		6/6	6/6		6/9	6/9		6/12	6/9

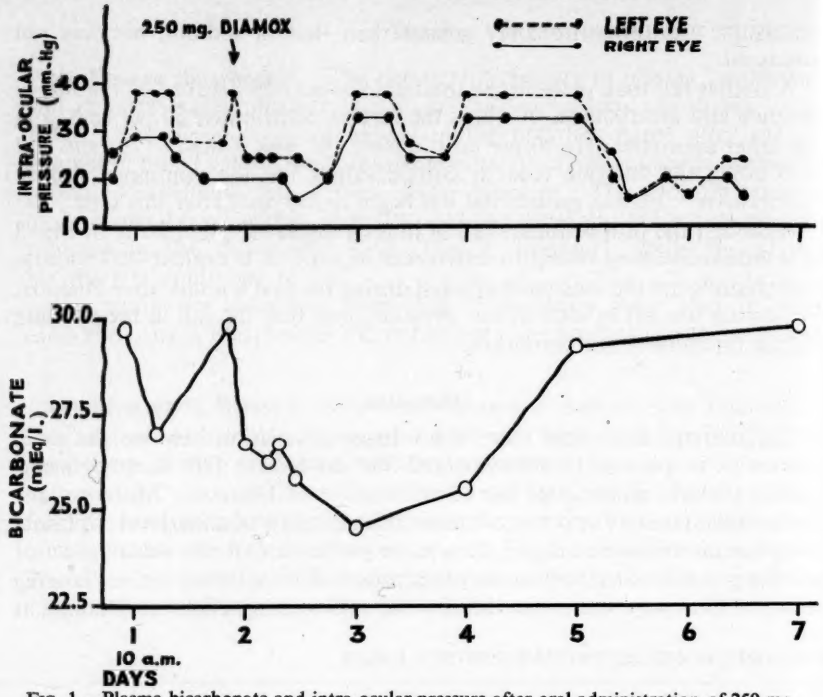

FIG. 1.—Plasma bicarbonate and intra-ocular pressure after oral administration of 250 mg. Diamox in a case of narrow-angle glaucoma.

determined by the fall in plasma bicarbonate (Counihan, Evans, and Milner, 1954; Schwartz and Relman, 1954). In fact, the fall in intra-ocular pressure is more closely associated with the fall in sodium, potassium, and chloride ions and with the concurrent increase in excretion of these ions.

Sodium in particular is intimately linked with the transference of water within the body and with its excretion. Neither the diuresis nor the naturesis which occur after Diamox can, however, explain its effect on the eye, for other diuretics such as chorothiazide, mictine, or the mercurials which also promote sodium excretion have no effect on the intra-ocular pressure (authors' unpublished work).

Neither are the aspects of chloride metabolism during Diamox therapy fully understood. According to our findings, the chloride concentration of the blood falls during the first few hours and then rises. This hyperchloraemic acidosis is compensatory for the loss of bicarbonate from the blood and is said to be due to a contraction of the extra-cellular fluid volume. Hyperchloraemia continues during prolonged Diamox therapy without change in the external chloride balance (Leaf, Schwartz, and Relman, 1954; Counihan and others, 1954; Maren, Wadsworth, Yale, and Alonzo, 1954). When the body is in this state the eye shews a steady decline in its

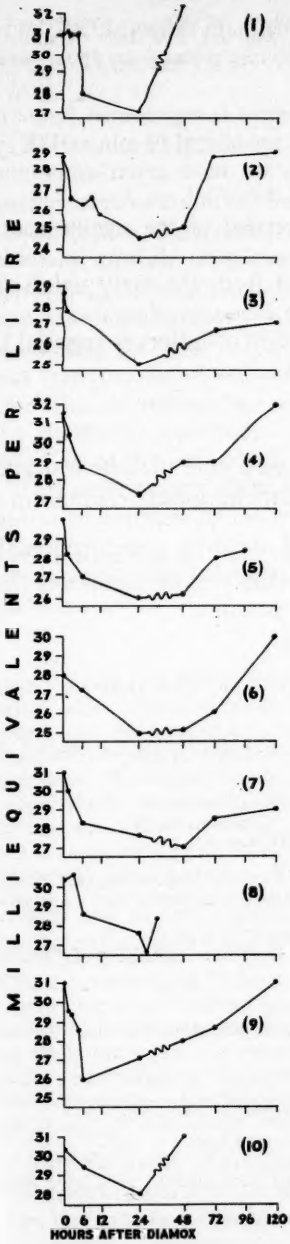

FIG. 2.—Plasma bicarbonate in ten glaucomatous subjects after oral administration of 250 mg. Diamox.

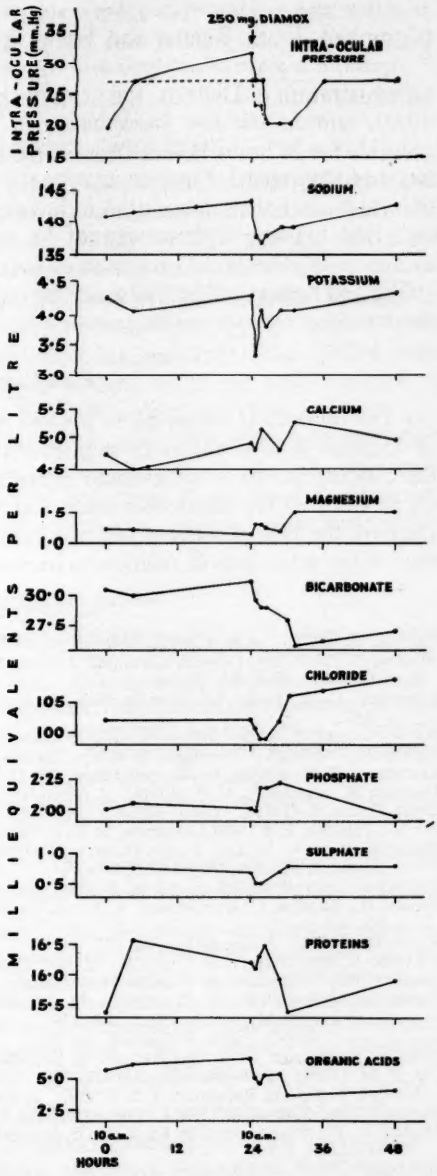

FIG. 3.—Intra-ocular pressure and electrolyte balance in Case 9, before and after oral administration of 250 mg. Diamox.

response to repeated doses of Diamox (Campbell and others, 1956), and in practice the response can be restored by giving potassium bicarbonate (Campbell, Jones, Renner and Tonks, 1957).

Again, if a state of acidosis and hyperchloraemia is engendered *before* the administration of Diamox, the urinary changes are absent or minimal (Kaye, 1955), and in the few experiments in which we have given ammonium chloride for 24 hours before Diamox the expected fall in intra-ocular pressure has not occurred. Further investigation is needed of the significance of chloride metabolism in relation to intra-ocular pressure. It is an interesting fact that massive oedema cannot be removed from the body unless the excretion of chloride is provoked as well as the excretion of sodium (*Lancet*, 1955), and it may well be that a similar combination of factors is essential for the lowering of intra-ocular pressure by osmotic means.

Conclusions

(1) The immediate reduction in plasma bicarbonate after the administration of Diamox is so slight as to suggest that it bears no direct relationship to the concurrent fall in intra-ocular pressure.

(2) A study of the electrolyte balance shows that after the administration of Diamox the fall in sodium and chloride is probably more significant than that of the other ions in relation to intra-ocular pressure.

REFERENCES

BECKER, B. (1957). *A.M.A. Arch. Ophthal.*, **57**, 793.
BRIGGS, A. P. (1922a). *J. biol. Chem.*, **52**, 349.
——— (1922b). *Ibid.*, **53**, 13.
CAMPBELL, D. A., JONES, M., RENNER, N. E. A., and TONKS, E. L. (1957). *Brit. J. Ophthal.*, **41**, 746.
———, TONKS, E. L., and JONES, M. (1956). *Ibid.*, **40**, 283.
CLAUDIUS, D. (1922). "Verhand. 34 Kongr. Dsch. Ges. inn. Med. Wiesbaden", p. 138.
COUNIHAN, T. B., EVANS, B. M., and MILNE, M. D. (1954). *Clin. Sci.*, **13**, 583.
DAVSON, H., and LUCK, C. P. (1956). *J. Physiol. (Lond.)*, **132**, 454.
DUKE-ELDER, S. (1957). *Trans. ophthal. Soc. U.K.*, **77**, 205.
———, PERKINS, E. S., and LANGHAM, M. E. (1956). *Arch. Soc. oftal. hisp.-amer.*, **16**, 259.
FRANCESCHETTI, A., MARTY, F., and DUBLER, H. (1956). "International Symposium on Aqueous Humour, Munich, May 14–15, 1956".
FRIEDENWALD, J. S. (1949). *Amer. J. Ophthal.*, **32**, June, Part II, p. 9.
GREEN, H., BOCHER, C. A., CALNAN, A. F., and LEOPOLD, I. H. (1955). *A.M.A. Arch. Ophthal.*, **53**, 463.
KAYE, M. (1955). *J. clin. Invest.*, **34**, 277.
KRAMER, B., and TISDALL, F. F. (1921). *J. biol. Chem.*, **47**, 475.
Lancet (1955). "Review on Diuresis from Carbonic Anhydrase Inhibition", **1**, 706.
LANGHAM, M. E. (1955). *J. Physiol. (Lond.)*, **128**, 78P.
——— and LEE, P. M. (1955). *Ibid.*, **130**, 27P.
——— ——— (1957). *Brit. J. Ophthal.*, **41**, 65.
LEAF, A., SCHWARTZ, W. B., and RELMAN, A. S. (1954). *New Engl. J. Med.*, **250**, 759.
LEE, P. M. (1955). *J. Physiol. (Lond.)*, **128**, 80P.
LETONOFF, T. Y., and REINHOLD, J. G. (1936). *J. biol. Chem.*, **114**, 147.
MANN, T., and KEILIN, D. (1940). *Nature (Lond.)*, **146**, 164.
MAREN, T. H., WADSWORTH, B. C., YALE, E. K., and ALONSO, L. G. (1954). *Bull. Johns Hopk. Hosp.*, **95**, 277.
SCHWARTZ, W. B., and RELMAN, A. S. (1954). *J. clin. Invest.*, **33**, 965.
TISDALL, F. F. (1923). *J. biol. Chem.*, **56**, 439.
WOLFSON, W. Q., COHN, C., CALVARY, E., and ICHIBA, F. (1948). *Amer. J. clin. Path.*, **18**, 723.

Brit. J. Ophthal. (1958) **42**, 739.

NEW METHOD OF OPERATION FOR DETACHMENT OF THE RETINA WITH TEARING OF THE MACULA LUTEA*

BY

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DETACHMENTS of the retina with a hole in the macula lutea or posterior pole are very difficult to cure by diathermy coagulation or electrolysis. To perform this operation it has been the custom to lay bare the sclera and resect the lateral rectus muscle in order to bring the posterior pole into view by rotating the eyeball. An Arruga speculum or other suitable glass spatula was then introduced, so that the region of the posterior pole could be measured with callipers and marked with indian ink, and after these preliminaries, the diathermy operation was begun. Some surgeons even resorted to resection of the lateral wall of the orbit (Krönlein's method).

This was time-absorbing and tiring, and usually provoked a marked post-operative reaction in the tissues surrounding the eyeball. The two cases described below gave me the idea of constructing a special "calibrated" electrode, and this led me to evolve a new and simpler method of approach to the macula.

Preliminary Case Reports

Case 1, a man aged 29, had a fresh traumatic retinal detachment, with a large convoluted vesicle which refused to flatten out after rest in bed. The hole in the macula lutea was round with sharp edges, as if stamped out. Two electrolytic punctures were made in the posterior pole, in order to evacuate the subretinal fluid before beginning the actual operation. To my surprise, on the second day after what I had regarded as a preliminary procedure, the retina had completely adhered. The aperture in the macula then became covered with a delicate exudate like a fine veil, and later quite disappeared.

The detachment healed completely and permanently, the visual acuity on discharge being 6/18, and 5 years after the operation 6/12.

This case showed me that a tear in the macula could be cured and closed by cauterization not of the macula itself but of its surroundings.

Case 2, a woman aged 52, had a traumatic retinal detachment with a hole in the macula lutea in her only remaining eye. The detachment occurred after the patient had fallen and struck her head on the pavement. A primary electrolytic-diathermy operation gave no result, but a cure was obtained by means of a special diathermy electrode, curved to fit the circumference of the eyeball. With this electrode, two cauterizations of the retina were performed in the region of the macula lutea. The detachment was permanently cured, and the visual acuity was 6/24 with −2 D sph., −2 D cyl., axis 15°.

This electrode, although useful, did not give complete satisfaction, since the straight section of the instrument passed gradually into the curved section. For this reason I could not calculate the exact distance of the coagulation

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from the margin of the cornea. I had to check the distance constantly with the speculum, and even had to cauterize while using the speculum, which impeded the procedure.

After many attempts, I succeeded in constructing a new electrode which I consider excellent. So that the distance of the coagulation from the margin of the cornea could be calculated more easily, I changed the shape of the electrode to a sharp right-angle, which formed a sort of elbow. In this way the length of the inner curve from the elbow to the end of the electrode can be accurately measured.

The Instrument

This electrode is made of stainless steel (Fig. 1). The straight section consists of a thicker non-insulated handle (*n*), and a more slender insulated shaft (*p*), which continues as far as the elbow (*pr*).

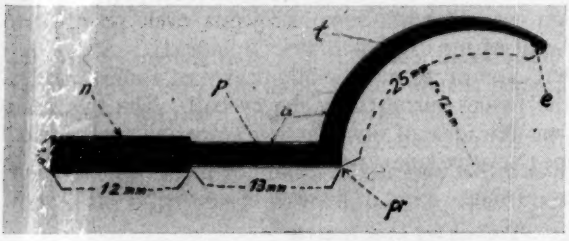

FIG. 1.—Longitudinal section of calibrated electrode, with curve 25 mm. long.

Section *n* is 12 mm. long and 2·6 mm. thick, and section *p* is 13 mm. long, so that the whole straight section is 25 mm. in length. The curved insulated section of the electrode begins at right angles with the elbow (*pr*), and continues in a curve (*t*), adjusted to the convexity of the sclera and gradually tapering to the end (*e*). The inner radius (*r*) is 12 mm. and the length from *pr* to *e* is exactly 25 mm. To avoid mistakes and for better orientation, the figure "25" marking the length of the inner curve of the electrode is engraved at the beginning of the handle (*n*). The curve is so designed that the coagulation does not occur too near the macula. In transverse section, the curve of the electrode is flat-convex (Fig. 2*a*), the inner surface of the curve being flattened. The edges of the curved section and the end of the electrode are rounded, and the surfaces of the electrode are smoothed by japanning. At *e*, on the inner edge of the curve, is the active part of the electrode, a small non-insulated plate, projecting slightly and polished smooth, about 1 sq. mm. in area (Fig. 2*b*).

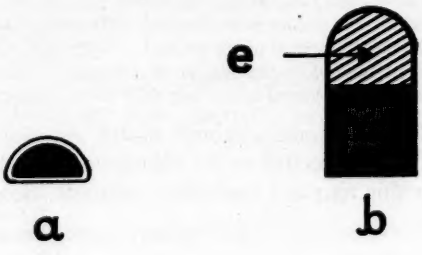

FIG. 2 (*a*).—Transverse section of curve of calibrated electrode.
2 (*b*).—Tip of electrode with active plate *e*.

Method of Use

Approach to the Region of the Macula Lutea.—The lateral rectus muscle is not resected, but is laid bare and divided lengthwise into halves for a distance of a few millimetres. Each half is then slightly nicked at its insertion so that a small window appears in the tendon (Fig. 3). Through this, the calibrated electrode is cautiously introduced in the direction of the posterior pole, exactly in the horizontal meridian, until the elbow (*pr*) touches the margin of the cornea (Fig. 4).

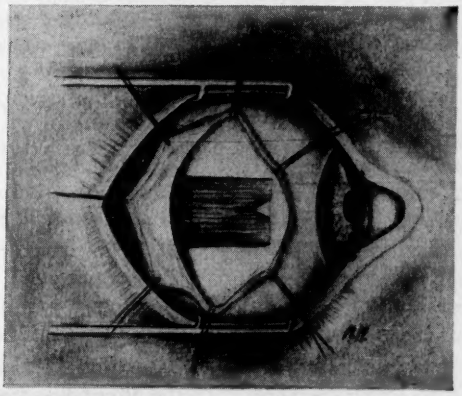

Fig. 3.—Opening in tendon of lateral rectus muscle.

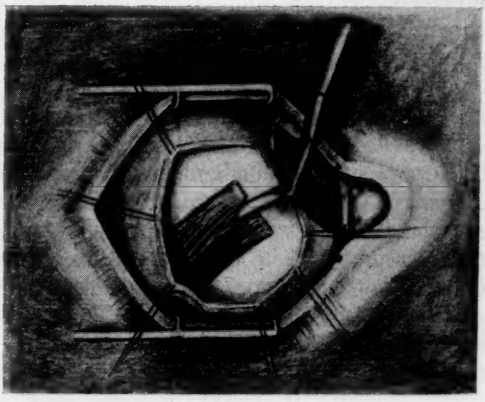

FIG. 4.—Introduction of calibrated electrode through opening in tendon, in direction of posterior pole.

The active end (*e*) will then be in contact with the sclera in the region of the posterior pole, at a distance of exactly 25 mm. from the margin of the cornea (Fig. 5).

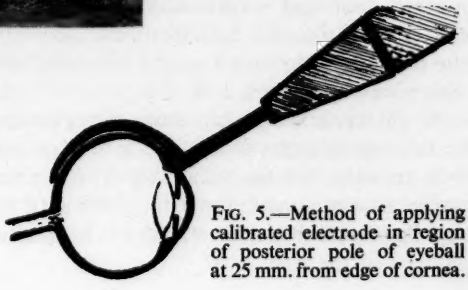

FIG. 5.—Method of applying calibrated electrode in region of posterior pole of eyeball at 25 mm. from edge of cornea.

Electric Current.—As the sclera is thickest at the back of the eyeball, a brief but fairly strong current, of at least 80 mA, is essential, since otherwise a sufficiently strong coagulation may not be achieved.

Site of Cauterization.—The electrode is aimed not at the macula lutea itself, but a little above it. When a cauterization has been performed in this position, the end (*e*) is moved so that it makes contact a little below the horizontal meridian and a second cauterization is performed.

Even if the coagulations are not visible, owing to the size of the detachment, a closer approach to the macula is not made, especially if the eyeball is normal or the refraction is not too great. In large eyeballs with a high degree of myopia, a distance of 1 or 2 mm. from the edge of the cornea may be marked with methylene blue; a cauterization performed with the elbow in this position will be effective at 26 or 27 mm. from the margin of the cornea. But this means diathermy may be carried out at the back of the eyeball at a chosen distance from the limbus.

Conclusion of Operation.—If inspection with the ophthalmoscope shows the coagulations to be well placed, the subretinal fluid may be released laterally and downwards by a micropuncture or scleral trephine, and the conjunctival wound may then be sutured.

Protection of the Macula from Direct Cauterization

It has previously been the custom to cauterize the hole itself. Safar (1953), for instance, with the aid of his Ziel-Ophthalmoskop coupled with a diathermic needle electrode, cauterized the macular hole at the moment when the light of the ophthalmoscope fell upon it. Mamoli (1936, 1937), Bangerter (1940), and Dellaporta (1953a, b) used needles 27 to 30 mm. long, insulated with japanning except at the extreme tip, and connected by a copper wire to the diathermy apparatus. This needle pierced the sclera in the region of the ora serrata, passed through the vitreous, and, under speculum control, reached the hole in the macula lutea for direct cautery. Bangerter (1954) has also described another method involving the surgical implantation of pieces of placenta. Meyer-Schwickerath (1956) cauterized tears in the macula by using a beam from an arc lamp, the action of which resembled that of the sun's rays on the naked eye during an eclipse (Sédan, 1956); this method caused permanent injury to the macula lutea, leaving a dark pigmented spot and central scotoma. Kettesy (1957) reported that he had cauterized a macular hole by direct solar rays; he achieved the apposition of the retina, but the visual acuity was only 0·08 after 6 weeks, and the macular vision was completely lost.

In the writer's opinion, every direct cautery of a hole in the macula lutea causes a permanent injury which is more serious than the hole itself.

It appears that macular tears do not always lie in the centre and do not cover the whole of the macula. Some of the sight cells are usually spared, and these valuable cells should not be finally destroyed by direct and violent cautery of the hole itself.

The central area of the macula slightly exceeds the optic disc in size, the diameter of the macula being about 2 mm. and that of the disc from 1·5 to 1·7 mm. The diameter of the central fovea itself, on the other hand, is only 0·2 to 0·4 mm. (Rauber and Kopsch, 1923; Eisler, 1930; Kolmer-Lauber, 1936; Duke-Elder, 1938). The whole area of the macula, therefore, is about 3 sq. mm., and that of the central fovea only 0·03 to 0·12 sq. mm. In the structure of the macula, we distinguish the "limbus" at the circumference, where the retina is most developed, reaching a thickness of 0·49 mm. Towards the centre we distinguish the "clivus", where the retina becomes gradually thinner, and the "fundus foveae" where the retina is only 0·075 to 0·12 mm. thick. The fundus is slightly concave and there is also sometimes a small depression, the "foveola", with a radius of about 40 μ. At the central fovea the retina is composed only of closely-set cones 80 μ long and 2·5 to 3 μ thick. Here there may be as many as 160,000 cones to the square millimetre, whereas beyond the region of the fovea the density is about 132,000 to the square millimetre. Thus the total number of cones in the central area of the retina is about 400,000, and that in the central fovea itself only about 16,000. The density of the cones in this central area gives evidence of the adaptation of the macula to highly-specialized functions, and at the centre of the fovea the cones are almost completely uncovered, so that the light is unimpeded, passing through only one retinal layer.

Holes in the macula lutea are not usually large. The largest may reach one-fifth or one-sixth of the size of the disc, with an area of about 0·5 sq. mm., and it may thus be assumed that the greater part of the macula is still functioning. Fortunately, such large tears are rare, and holes appear less frequently in the macula than at the periphery of the retina. The small thin central area is surrounded by the thicker limbus, which acts as a sort of protective wall to the delicate and sensitive centre. At the periphery the retina is also very thin, being only about 0·1 mm. thick in an area extending from the ora serrata to the equator. Tears therefore occur most frequently in the anterior part of the retina, which is most exposed to tearing, whether through trauma or through degenerative changes in the form of cysts.

When, however, a macular hole does appear, a permanent loss of central vision and even complete blindness threatens, and such tears must be treated with the greatest care for conserving the remaining living cells.

According to Abramowicz (1952), the posterior pole of the eyeball is 31 mm. from the limbus on the temporal side. The centre of the macula lutea lies somewhat towards the temporal side of the posterior pole and a little below the horizontal meridian (Rauber and Kopsch, 1923; Duke-Elder, 1940; Eisler, 1933; Kolmer-Lauber, 1936). It should therefore be assumed that, in the normal eyeball, the centre of the macula lutea lies about 30 mm. from the edge of the cornea. If the elbow of the calibrated electrode described above is placed at the edge of the cornea the tip will form a coagulate 25 mm. from the limbus.

Experiments on rabbits (Mądroszkiewicz, 1948) showed that the action of the diathermy current is not limited to the actual site of the electrode, but always radiates 1–2 mm. from it. The effect of the calibrated electrode will thus reach as far as 27 mm. from the edge of the cornea, leaving a space of 2 mm. between the edge of the macula and the range of activity of the electrode. This distance is far enough to protect the macula from the harmful effects of the diathermy current, but near enough to bring about the apposition of the margin of the tear to the substratum. If the hole in the macula is very small and "punched out", the destruction of the cones may not be extensive. If it is a small slit, the edges of the hole may gape, but there will be no actual defect in the tissues, and only a few cones may have been destroyed while the majority remain unscathed. In such a case, after the retina has re-adhered, the macular vision may reach 6/12 or even better.

Keeney (1955) gives a graph (Fig. 6) showing the parts of the macula on which greater or lesser degrees of visual acuity depend. Thus the loss of

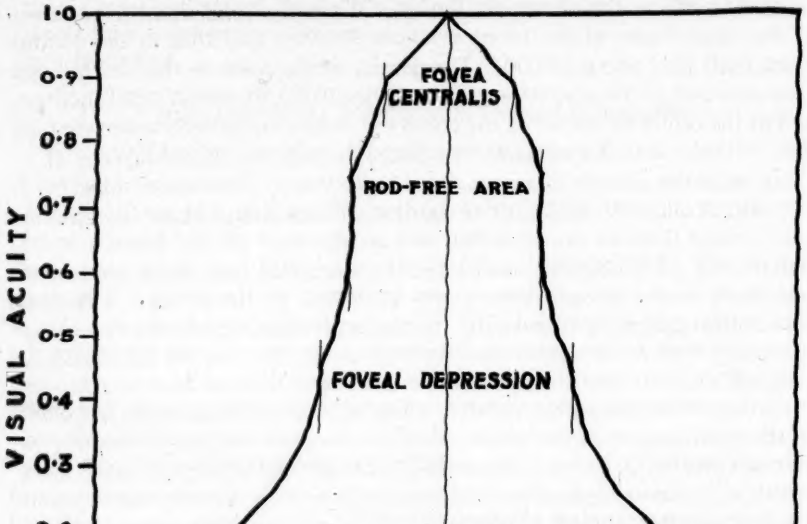

FIG. 6.—Graph (according to Keeney, 1955, p. 649, based on studies by Ludvigh, 1941), illustrating the degree of visual acuity in particular parts of the macula lutea.

the central fovea causes the loss of the highest acuity and the visual acuity is diminished to 0·8 or 0·7. If the greater part of the fovea undergoes destruction, the visual acuity falls to 0·4, and if only the limbus is left, the acuity will be only 0·1 or 0·2, after the retina has re-adhered. Below this graph I have added the distances in fractions of a millimetre, so that reckoning from the centre, each degree equals one-fifth of a millimetre. The whole macula occupies a space with a radius of 5° from the centre, corresponding to a diameter of 2 mm. A hole in the macula may be complete when the break affects the whole thickness of the retina (Fig. 7A), or it may be incomplete when either the internal limiting membrane (Fig. 7B) or the external surface remains intact (Fig. 7C).

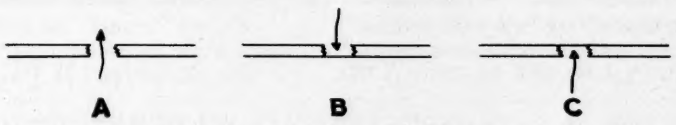

FIG. 7.—Diagram of complete (A) and incomplete (B and C) holes in the macula lutea.

At the periphery direct cautery may be performed, since the peripheral parts of the retina, especially on the temporal side or below, are not so essential for sight, but in dealing with a hole in the macula lutea it is necessary to cause the formation of inflammatory foci in the *vicinity*, to which the retina will adhere after the subretinal fluid has been evacuated. A hole in the macula lutea, if it has not been directly cauterized, will become completely invisible after the re-adherence of the retina. The edges will coagulate with the substratum without scar formation, and those cones which still function will be saved. Three cases are described below as examples.

Case Reports

Case 3, a woman aged 56, had received a severe blow on the head 10 days before admission to hospital; she had spent 4 days in bed, and on getting up had noticed a mist before the right eye.

On November 30, 1953, the visual acuity in the right eye was 1/20 with difficulty; there was no improvement with glasses, and she could not read from the chart. In the left eye it was 6/12 partly, with −1D cyl., axis 90°; for near it was 0·5 with +2·5 D sph., +1 D cyl., axis 180°.

The retina in the right eye was detached laterally, inferiorly, and centrally, and was convoluted. There was a small hole in the macula, a second at the meridian at 6.30 o'clock, and a third at the periphery at 7.30 o'clock, 11–12 mm. from the limbus.

On December 11, 1953, four superficial diathermy cauterizations were performed in the vicinity of the macula (one at 26 mm. and three at 27 mm. from the limbus) using the calibrated electrode with a current of 60–120 mA. The peripheral tears were subjected to a few superficial cauterizations at a distance of 13 mm. from the limbus. The subretinal fluid was evacuated by electrolytic micropunctures, and the conjunctiva was sutured.

The post-operative course was normal. On discharge, the visual acuity was 6/18 partly; for near it was 1·2 with +3 D sph. The retina was adherent and partially pigmented, with post-operative foci near the macula and a few peripheral foci.

After 1 year and 2 months the visual acuity in the right eye was still 6/18 partly; there was no improvement with glasses, and near vision was 0·6 with +3 D sph.

Case 4, a boy aged 19, who had been hit on the right eye with a stick, was admitted to hospital on September 29, 1956. The visual acuity in the right eye was 1/20 with +6 D. sph., and in the left 6/6 partly with +2 D sph.

The retina in the right eye was detached centrally and superiorly, and convoluted. There was a small hole in the macula and dialysis of the retina above at 12 o'clock. On October 15, 1956, three coagulations were performed with the calibrated electrode at a distance of 25 mm. from the limbus laterally in the vicinity of the macula, seven superficial applications surrounding the peripheral hole, and one at the vertical meridian 20 mm. from the limbus. A micropuncture was made superiorly, through which a large quantity of subretinal fluid was evacuated.

The post-operative course was normal. On discharge on November 17, 1956, the visual acuity in the right eye was 1/18 with +6 D sph. On February 21, 1957, it was 6/36, the retina was adherent, with pigmented foci in the vicinity of the macula, and no tear was visible. A few post-operative pigmented foci were seen at the periphery.

Case 5, a man aged 54, a manual worker from Chorzów, had been operated on elsewhere in 1954 for cataract of the left eye, the sight which had been almost lost. He had worn correction −8 D sph. since childhood, and on April 10, 1956, he noticed that the sight of the right eye was deteriorating.

On admission to hospital on May 2, 1956, the visual acuity in the right eye was counting fingers at 5 metres with −10 D sph., and in the left eye hand movements, not improved with glasses. The retina of the right eye was detached below both temporally and nasally, and there was a fissure-like tear in the macula. The left eye was aphakic, and the retina was almost completely detached, especially in the lower nasal quadrant. On June 6, 1956, the lateral rectus was divided with a conical probe, a small window was made in the muscle just beside the sclera, and three superficial diathermy coagulations were performed with the calibrated electrode in the vicinity of the macula at 25 mm. from the limbus. Three coagulations were then made on the meridians at 5.30, 7.30, and 8.30 o'clock at 20 mm. from the limbus, a few more at 15 mm., and nine at 9 mm. The subretinal fluid was evacuated with a 1·5-mm. trephine of the sclera and a puncture of the choroid with a diathermy needle.

The post-operative course was normal, the retina re-adhered, and the visual acuity on discharge was 6/24 with −8 D sph.

In the five cases described above only single tears were found in the macula itself. In Cases 2, 3, and 4, there were also peripheral tears. In Cases 2 and 5 the retinal detachment with macular hole was unilateral.

In Cases 1, 2, 3, and 4 the macular hole was due to trauma, in Cases 1 and 4 to direct trauma to the eyeball, and in Cases 2 and 3 to indirect injury caused by a severe blow on the head. In Case 5 on the other hand, a macular hole arose without apparent cause in an eye with moderate myopia (−8 D sph.) and this was the only useful eye since the other was practically blind through post-operative aphakia and a previous complete retinal detachment.

In all five cases the macular holes were complete, according to the classification of Keeney (1955). The existence of a break in the continuity of the retina was proved by the fact that there was not the slightest reaction to the

movement of the ophthalmoscope. The presence of this reflex, according to Vogt (1936), shows that the internal limiting membrane is intact.

In all five cases the indirect method of cauterizing with a calibrated electrode gave satisfactory results and conserved the sight, and the final results were far better than in other cases described in the literature, in which the normal central (macular) vision was lost sooner or later after the operation because the hole was cauterized directly and the remaining macular cones destroyed.

Vogt (1936), who stated that both diathermy and chemical cauterization were unsuitable for macular holes because they destroyed the most valuable part of the retina, attempted to surround the hole with catholytic punctures. He achieved fairly satisfactory visual results (0·1, later improved to 0·5), but this was an "heroic" procedure on which not everyone might venture. He also remarked that the edges of macular holes adhered to the pigment epithelium when the coagulations were made in their vicinity; he was therefore on the right path, but his method of operation was too complicated.

From the practical point of view, the method here described shortens the time of operation (from 60 or 90 minutes to 30 minutes), and effectively achieves permanent re-apposition of the retina while sparing any central cones which may have survived the original trauma.

From this method of operation for tears in the macula, for which a calibrated electrode 25 mm. in length has been devised, a new system of treating retinal detachment in general has been developed by the construction of additional calibrated electrodes 15 and 20 mm. in length, which may be used according to the position of the holes. This system, which I propose to call the Polish method, will be described in detail in a future publication.

Summary

The author describes his method of treating retinal detachments with tears of the macula lutea, using a "calibrated" electrode of his own design, which produces an electro-coagulation at an accurately measured distance from the limbus without the use of a measure, callipers, or Indian ink.

The operation is performed without resecting the lateral rectus muscle, the electrode being cautiously introduced through a small opening in the muscle, and being so shaped that a diathermy coagulation can be made near the posterior pole in the vicinity of the macula, without direct injury to the macula itself.

This method is effective in achieving re-adherence of the retina without destroying any remaining macular cones.

REFERENCES

ABRAMOWICZ, I. (1952). "Chirurgia oka w zarysie". P.Z.W.L., Warsaw.
BANGERTER, A. (1940). *Ophthalmologica* (*Basel*), **100**, 351.
——— (1954). *Ibid.*, **127**, 346.

DELLAPORTA, A. (1953a). *Klin. Mbl. Augenheilk.*, **122**, 99.
——— (1953*b*). *Cited by* Safar (1953).
DUKE-ELDER, S. (1938). "Text-book of Ophthalmology", vol. 1. Kimpton, London.
——— (1940). *Ibid.*, vol. 3.
——— (1954). *Ibid.*, vol. 6.
EISLER, P. (1930). "Die Anatomie des menschlichen Auges", *in* F. Schieck and A. Brueckner, "Kurzes Handbuch für Ophthalmologie", vol. 1. Springer, Berlin.
KEENEY, A. H. (1955). *Amer. J. Ophthal.*, **39**, 648.
KETTESY, A. (1957). *Klin. Mbl. Augenheilk.*, **130**, 465.
KOLMER-LAUBER, H. (1936). "Auge", *in* W. von Moellendorff, "Handbuch der mikroskopischen Anatomie des Menschen". Springer, Berlin.
LINDNER, K. (1933). *Z. Augenheilk.*, **81**, 186.
——— (1945). "Operative Behandlung der Netzhautabloesung", *in* R. Thiel, "Ophthalmologische Operationslehre", vol. 2. Thieme, Leipzig.
LUDVIGH, E. (1941). *Amer. J. Ophthal.*, **24**, 303.
MAMOLI, L. (1936). *Atti Soc. oftal. ital.*, **41** (Abs. in *Zbl. Ophthal.*, 1937, **37**, 252).
——— (1937). *Ann. Oculist.* (*Paris*), **174**, 309 (Abs. in *Zbl. Ophthal.*, 1937, **39**, 409).
MĄDROSZKIEWICZ, M. (1948). *Przegl. lek.*, **4**, 292.
——— (1958). *Klin. Oczna.*, **28**, 71.
MEYER-SCHWICKERATH, G. (1956). *Ann. Oculist.* (*Paris*), **189**, 533.
RAUBER, A., and KOPSCH, F. (1923). "Das Sehorgan", *in* "Lehrbuch und Atlas der Anatomie des Menschen". Thieme, Leipzig.
SAFAR, K. (1953). "Elektrochirurgie am Auge". Springer, Berlin.
SÉDAN, J. (1956). *Ann. Oculist.* (*Paris*), **189**, 337, 602.
VOGT, A. (1936). "Die operative Therapie und die Pathogenese der Netzhautabloesung". Enke, Stuttgart.

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RETINAL DETACHMENT AT THE POSTERIOR POLE*

BY

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THE common feature of the cases to be described in this communication is a retinal detachment localized to, or apparently originating from, the region of the macula; most are myopes and some have posterior staphylomata. Cases of central serous retinopathy are excluded.

Case Reports

Case 1, a male, aged 52, had had a right macular haemorrhage about 20 years previously, and for a period of 4 months had noticed deterioration of the visual acuity of the left eye. The right eye showed a posterior staphyloma and advanced macular degeneration typical of myopia; the left eye had a central retinal detachment occupying the area of a posterior staphyloma (Fig. 1). The visual acuity was 3/60 eccentrically in the right eye with −18 D sph., −3 D cyl., axis 90°, and 6/36 in the left eye with −20 D sph. No hole was found. The inset to Fig. 1 is a diagram of the lower edge of the lesion seen with the fundus slit-lamp. There was no detachment of the vitreous.

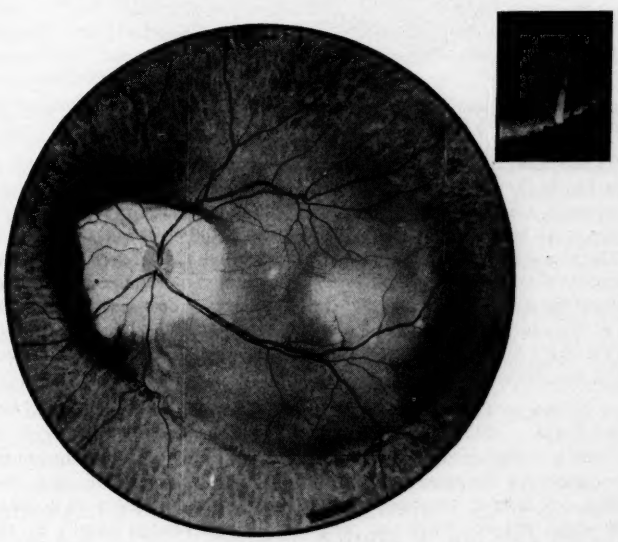

FIG. 1.—Left fundus of Case 1, showing a retinal detachment without hole, in the area of a posterior staphyloma. Inset is a diagram of the edge of the area as seen with the fundus slit-lamp.

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† Now at Bristol Eye Hospital.

Case 2, a male, aged 38, had no knowledge of the time of onset of poor vision in the right eye. The visual acuity was 6/60 in the right eye with −17 D sph., −1 D cyl., axis 60°, and 6/6 in the left eye with −15 D sph., −1·5 D cyl., axis 90°. Fig. 2 shows the area of retinal detachment (dark colour); no retinal hole was found. It seems likely that initially the detachment was localized to the central, staphylomatous area which lies within the dotted line in the diagram. The vitreous was detached; its posterior face lay just behind the lens and its main mass was in the lower part of the globe.

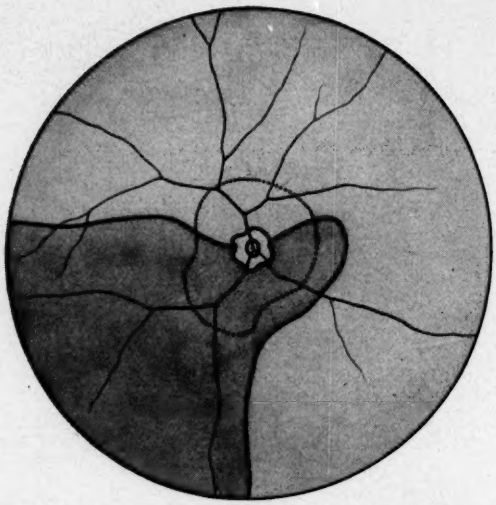

FIG. 2.—Right fundus of Case 2. The dotted line indicates the limits of a posterior staphyloma, while the shaded area shows the part of the retina detached.

Case 3, a female, aged 57, had typical macular degeneration of the right eye which had caused poor acuity for one year. A "floater" had been noticed centrally in the left field 3 years previously, followed, a year later, by a "shadow" temporally and deterioration of central vision. At that time no central hole was noted in the detachment which was present. The visual acuity in the right eye was 6/36 with −7 D sph., and in the left eye hand movements with −7·75 D sph. Fig. 3 (opposite) shows the posterior pole of the left eye as seen with the fundus slit-lamp; there is a localized but deep central detachment with a large hole at the macula and a smaller one supero-nasally. The posterior face of the vitreous lay a short distance behind the lens; most of the vitreous had retracted to the lower part of the globe.

Case 4 (very similar to Case 3), **a female, aged 56,** wore a correction right −10 D sph. and left −0·5 D sph., −0·25 D cyl., axis 90°. The right eye had a divergent strabismus. There had been a complaint of "floaters" in the right temporal field during the 6 weeks before attendance; for the same period a black patch had been noticed in the centre of the right field. A hole at the right macula was surrounded by a wide area of retinal detachment which did not reach the periphery: it was limited nasally by the disc but extended to the equator temporally; above and below, the edge of the detached area described arcs between these two points.

Case 5, a female, aged 72, had lost the central vision of the left eye 5 years previously because of a disciform degeneration, and more recently the same condition had developed

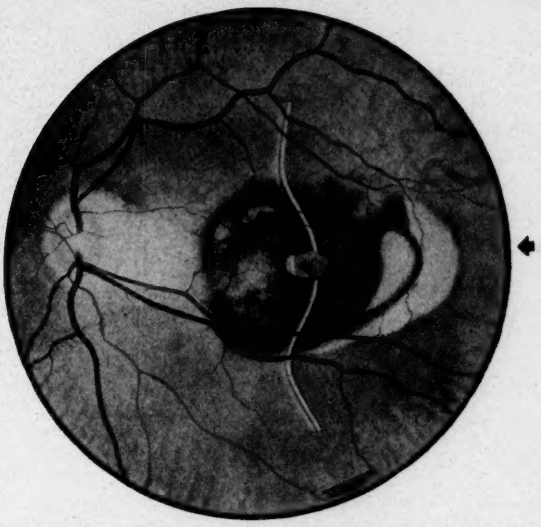

FIG. 3.—Left fundus of Case 3, showing the macular region as seen with slit-lamp; in addition to a macular hole, there is another supero-nasally.

in the right eye. The visual acuity was only "counting fingers" in both eyes and she was emmetropic. There was a hole at the left macula and a wide area between the upper and lower temporal vessels showed a retinal detachment, presumably because of contraction of the "subretinal" haemorrhage and exudate which caused the condition. The ophthalmoscopic appearances were similar to those in Fig. 3.

Two further cases may be mentioned although they may well not strictly belong to this series.

Case 6, a female, aged 24, had a wide area of retinal detachment posteriorly in the left eye extending well beyond the disc and macula; infero-nasally it reached the ora serrata between 6.30 and 8.30 o'clock. About 2 years before the retinal separation took place there had been a posterior detachment of the vitreous. The visual acuity was 6/9 in the right eye with −11 D sph., −1 D cyl., axis 180°, and 6/24 in the left eye with −14 D sph., −1 D cyl., axis 180°.

Case 7, a male, aged 59, had a moderately advanced cataract in the right eye. The left eye showed a wedge-shaped shallow detachment, based at the temporal periphery, the apex of which extended just nasal to the macula; the vitreous showed only a postero-superior detachment. No hole was present in either retina. The visual acuity in the left eye was 6/6 with −5·25 D sph., −1·5 D cyl., axis 65°.

Discussion

Cases 1 and 2 were seen for the first time almost 2 years ago; their discovery stimulated a careful search of the central area of the fundi of high myopes and others, but it has been possible to add only five more cases. It is hoped that the publication of this paper may result in a wider search. However, it must be admitted that this new syndrome of a retinal detachment limited to, or originating from, a posterior staphyloma and without a hole

is probably rare. Indeed, the retina in the area of a posterior staphyloma normally seems to be very reluctant to become detached, especially when choroido-retinal degeneration is marked. It is also necessary to admit that final certainty about the absence of a hole in the retina is impossible. The retina near the disc was carefully searched as being a likely site for holes which would be difficult to see. This form of detachment may be another cause of deterioration of central vision in high myopes, but choroido-retinal degeneration probably precedes it.

Posterior annular detachment of the vitreous with, occasionally, a corresponding ring of retinal detachment has been described by Adamantiadis (1951) and Adamantiadis and Rangabi (1950, 1952). Their cases do not seem to resemble those described in this paper.

Vail (1941, 1946) described two eyes in one patient, which had *peripheral* scleral ectasias overlying retinal detachments without holes. Later Vail (1949) described a series of similar cases in which six of ten eyes had retinal tears.

The findings in Case 2 suggested that a spread to the periphery of the primarily central staphylomatous detachment might account for those cases of simple detachment in which no hole can be found. Accordingly, a search was made of the records of the Detachment Clinic at the Institute of Ophthalmology. To this clinic are referred for assessment cases from the surgeons of Moorfields Eye Hospital and other London hospitals; it is very probable that especially difficult cases tend to be referred, so that one would expect a very high proportion of the hole-less detachments occurring in these hospitals to be included in the Clinic's records. Very few cases of simple detachment in which no hole was eventually discovered were to be found in the records; the majority of them were aphakic and their fundi were difficult to see, or else they had total detachments with retinal folds which might easily have hidden holes. Cases 5 and 6 were discovered in the search of the records.

The mechanism of these detachments is not easy to explain. It is generally held that a hole at the macula may exist without a retinal detachment (Duke-Elder, 1940), and conversely, as for example in Cases 1, 2, 6, and 7, a posterior detachment can exist without any (macular) hole. The evolution of these posterior detachments is probably different, then, from that of the vast majority of peripheral detachments. Even detachment of the vitreous in the area was not regularly present. The likeliest proximate "cause" is the central choroidal and retinal degeneration of myopia which must alter the ability of the two main retinal layers to adhere together; local conditions in Cases 1 and 3 must have bound the two layers together at the edge of the main area of degeneration, thereby preventing spread of the detachment to the periphery. In some of the cases, a localized staphyloma almost certainly contributed to the production of the detachment; in others a more diffuse staphyloma may have been present, though it was not obvious.

One case which is now under observation may yield useful information; oedema is present around the macula but neither a hole nor detachment exists. The visual acuity in the left eye is 6/12 with −7 D sph. No detachment of the vitreous can be seen. In the right eye, which has had a successful operation for peripheral detachment, the corrected visual acuity is 6/6. The clinical appearances are not those of central serous retinopathy.

Differential diagnosis of retinal detachments localized to the central area is important; the cause is less likely to be "simple" when the eyes affected are not myopic. A patient probably not in the category described in this paper, who has recently been examined, has a small, flat, somewhat pigmented area just temporal to the left disc and a detachment round the macula. The visual acuity is reduced only to 6/18. The diagnosis lies between malignant melanoma and choroiditis, probably the former.

Summary

A retinal detachment, without hole, localized to the area of a posterior staphyloma in a highly myopic eye is described (Case 1, Fig. 1). Case 2 (Fig. 2) had a similar condition but the detachment had spread to the periphery inferiorly. Cases 6 and 7 (both myopic) had central hole-less retinal detachments extending to the periphery in one sector. Case 4 had a detachment over a wide area posteriorly, without staphyloma, and a hole at the macula. Case 3 (Fig. 3) had a very localized central detachment with two holes, one at the macula; there was much underlying "myopic" choroidal degeneration. Case 5, an emmetrope, had a central detachment with a macular hole, following disciform degeneration of the macula.

It is suggested that the degeneration commonly seen at the posterior pole in myopic eyes is the main factor in causing these retinal separations, since neither holes nor even detachment of the posterior vitreous were regular findings; a posterior staphyloma played an important part in some cases.

I wish to record my thanks to Sir Stewart Duke-Elder for his helpful criticism in the preparation of this paper; to Mr. L. G. Fison for his generous co-operation in the examination of the patients; to Mr. G. Mouzas for his kindness in translating the articles in Greek; and to Dr. Peter Hansell, Mr. T. Tarrant, and Mr. N. Jeffreys for the preparation of the illustrations.

REFERENCES

ADAMANTIADIS, B. (1951). *Arch. Ophtal.*, **n.s. 11**, 457.
——— and RANGABI, O. (1950). *Bull. Soc. hellén. ophtal.*, **18**, 403.
——— ——— (1952). *Ibid.*, **20**, 31.
DUKE-ELDER, S. (1940). "Text-book of Ophthalmology", vol. 3, p. 2755. Kimpton, London.
VAIL, D. (1941). *Amer. J. Ophthal.*, **24**, 403.
——— (1946). *Ibid.*, **29**, 785.
——— (1949). *Ibid.*, **32**, 1111.

Brit. J. Ophthal. (1958) 42, 754.

TEAR GLUCOSE IN DIABETICS*

BY

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WITH THE TECHNICAL ASSISTANCE OF

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THE purpose of this investigation was to evaluate a method of screening suspected diabetics, suitable for those without hospital facilities. This has been made possible by the recent use of a specific enzyme, glucose-oxidase, which is so sensitive as to detect glucose in solution in concentrations as low as 5 mg./100 ml. A commercial preparation, Clinistix (Ames Co.), has been used to detect glycosuria, to estimate blood sugar levels and tear glucose in diabetics (Hunt, Gray, and Thorogood, 1956; Kohn, 1957; Lewis, 1957). In diabetes associated with hyperglycaemia there is an increase in tear glucose concentration and because it was possible that there might be a quantitative as well as qualitative relationship between tear glucose levels and blood glucose levels, two series of tests were done.

Method

Qualitative Tests.—In 200 diabetics the tear reaction was performed and compared with the blood sugar levels. The tip of a Clinistix was applied to the everted lower conjunctiva and moistened with tears, and the result was read after a minute. The patient was told to look up, so as to prevent the stick touching the cornea. Where the stick was not adequately moistened, it was wetted with water and reapplied. The blue colour change is due to an incorporated indicator and is dependent on glucose concentration and the time taken to read the result, so that some standard timing is desirable. The colour changes were arbitrarily divided into no change (white), green-blue, light blue, blue, and deep blue. Similar blue shades to these are found on the Clinistix bottle.

Quantitative Tests.—These were carried out on diabetic and non-diabetic subjects. 0·1 ml. of tears was taken and the total reducing substances found by the method of King (1951). The tears were also tested with Clinistix, and a guide to the amount of glucose present was obtained by comparing the results with the colour changes seen in aqueous solutions of known strengths of glucose.

* Received for publication January 14, 1958.

Results

Qualitative Tests.—No strict correlation was found but a general trend was apparent (Figure). Deep blue colours suggested a blood sugar over 250 mg./100 ml., and lighter shades of blue suggested levels between 150 and 250 mg./100 ml. In some cases positive tear tests were obtained with blood sugars at 100 to 150 mg./100 ml. It is possible that these results represent a lag from previous hyperglycaemia. A negative result often indicated normoglycaemia, but inefficient application, lack of co-operation, and faulty Clinistix which turned brown through light exposure accounted for some failures in testing hyperglycaemia. Of 119 cases in which hyperglycaemia was present, a positive colour change was seen in 101 (85 per cent.). Taking the group as a whole, a positive tear test was obtained, irrespective of the blood sugar levels, in 131 out of 200 diabetics. In a control series of fifty readings on normal subjects, the low glucose concentration and sensitivity of Clinistix was such that no reaction occurred within 1 to 2 minutes.

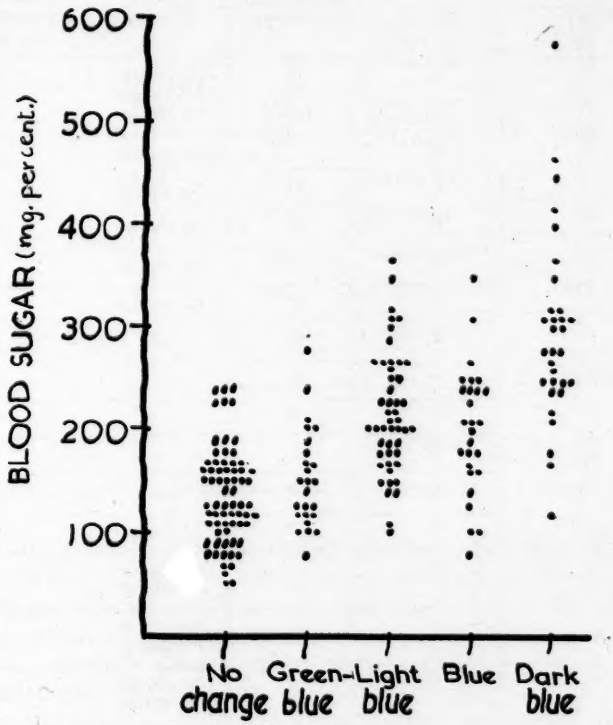

FIGURE.—*Colour changes related to percentage blood sugar.*

Quantitative Tests.—The Table shows the blood sugar levels, total tear reducing substances, and Clinistix reaction in thirty subjects (fifteen diabetic and fifteen non-diabetic). In the control series of non-diabetics the range of total reducing substances was 0 to 40 mg./100 ml. (average 14 mg./100 ml.). Feeding with large amounts (*i.e.* 100 g. glucose) produced tear concentrations capable of giving faint colour changes, but only after a delay of 3 to 5 minutes. In the diabetics there was the expected increase in levels but these bore no definite relationship to the blood sugar. When the total reducing substances were above the normal range with a minimal Clinistix reaction, it is probable that non-glucose substances were responsible.

Discussion

It has been stated that subjects with normal carbohydrate metabolism have a low glucose concentration in their tears. Values given have varied

TABLE
RESULTS IN FIFTEEN NORMAL SUBJECTS AND FIFTEEN DIABETICS

Series	Subject	Blood Sugar (mg. per cent.)	Clinistix Reading	Total Reducing Substances in Tears (mg. per cent.)
Normal Subjects	A	77 83 126	No change No change No change	20 26 40
	B	—	No change	20
	C	83	No change	—
	D	90	No change	16
	E	87	No change	22
	F	97	No change	—
	G	82	—	17
	H	82	—	10
	I	71	—	12
	J	75	—	10
	K	70	—	11
	L	75	—	15
	M	— —	No change No change	0 4
	N	— —	No change No change	6 10
	O	— —	No change No change	16 12

continued—

TABLE—(*continued*)

Series	Subject	Blood Sugar (mg. per cent.)	Clinistix Reading	Total Reducing Substances in Tears (mg. per cent.)
Diabetics	a	300	Dark blue	41
	b	160	Blue	67
		206	Light blue	50
		267	Light blue	53
		243	Light blue	57
		203	Green-blue	43
	c	110	No change	21
		94	No change	19
		100	No change	10
	d	106	Light blue	67
		120	Light blue	73
		100	Light blue	60
	e	167	Light blue	67
		120	Blue	120
		143	Blue	150
	f	220	Light blue	116
		173	Light blue	83
		186	Green-blue	33
	g	167	Green-blue	26
		100	Green-blue	33
		160	No change	26
	h	310	Green-blue	20
	i	133	No change	15
	j	280	Green-blue	20
	k	250	Dark blue	105
	l	—	Green-blue	36
	m	—	Blue	62
	n	—	Light blue	32
	o	—	Light blue	23
		—	Blue	55

widely from zero to 65 mg./100 ml. of total reducing substances. Giardini and Roberts (1950) found that the total reducing substances in tears averaged 6·06 mg./100 ml., of which 41 per cent. (2·5 mg./100 ml.) was glucose. Our results have not differed greatly from theirs. The highest reading of 40 mg./100 ml. was only obtained after ingestion of 100 g. glucose. The method of King and Garner (King, 1951) does not give the true glucose level but a higher figure depending on the additional non-glucose reducing substances present. Glutathione, a reducing substance normally present in

tears, is not included, as it is precipitated with the proteins. Chromatography for sugars was done on several occasions and showed that glucose was the only sugar present.

The test has the disadvantage of being temporarily uncomfortable in a minority of patients but no after-effects were found. Filter or absorbent paper, as used in Tes-Tape (Eli-Lilly), would be preferable, but its sensitivity is too low for use with tears. An enzyme strip combining a non-irritant absorbent tape with the sensitivity of Clinistix might be of more practical value. The commonest cause of failure of the test was inadequate wetting of the Clinistix with tears.

On the basis of these tests it is apparent that the tear sugar level is often raised in diabetics, and this can be used as a simple test to confirm the diagnosis. In our experience a blue coloration developing at 1 to 2 minutes indicated diabetes, and the deeper the colour the greater the certainty of the diagnosis.

Summary

In 200 diabetics blood sugar levels above 160 mg./100 ml. were present in 119, and in 85 per cent. the level of tear glucose was such to produce a positive reaction. 15 per cent. showed no colour change, so that a negative test cannot be used as evidence against the presence of diabetes. Under the same conditions normal subjects showed no reaction.

We should like to thank Dr. U. Ledingham, Mr. J. Minton, and Dr. D. N. Baron for their helpful criticism and advice, and the Ames Co. for supplying the Clinistixs.

REFERENCES

GIARDINI, A., and ROBERTS, J. R. E. (1950). *Brit. J. Ophthal.*, **34**, 737.
HUNT, J. A., GRAY, C. H., and THOROGOOD, D. E. (1956). *Brit. med. J.*, **2**, 586.
KING, E. J. (1951). "Micro-analysis in Medical Biochemistry", 2nd ed., Churchill, London.
KOHN, J. (1957). *Lancet*, **1**, 213.
LEWIS, J. G. (1957). *Brit. med. J.*, **1**, 585.

Brit. J. Ophthal. (1958) **42**, 759.

CASE NOTES

FUNDUS CHANGES IN UVEO-MENINGITIS*

BY

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THE association of angioid streaks in the ocular fundi with pseudo-xanthoma elasticum, Paget's disease and general arterial disease is well known. The present case is interesting not merely because of the development of a condition similar to angioid streaks which has not hitherto been described in uveo-meningitis, but also because it sheds some light on their causation.

Case Report

A **housewife aged 44** complained of bilateral dimness of vision of one week's duration at the time of reporting for treatment in May, 1957. Some photophobia and ocular discomfort were also present. There was no history of antecedent disease. Her teeth were septic and she had experienced joint pains on and off and more recently a constant severe headache.

Examination.—An anterior uveitis affected both eyes with a fine vitreous haze, though the fundi could be seen to be normal. The visual acuity was reduced to 6/12 in each eye, not correctable by lenses.

Treatment.—Atropine drops 1 per cent. thrice and cortisone ointment 2·5 per cent. four times daily quickly brought relief for a time.

Progress.—3 months later she presented herself again with pain, severe curtailment of vision and redness of both eyes, and greying and dropping of hair on the scalp. She was admitted to the Victoria Memorial Eye Hospital, Colombo, on July 25, 1957.

Examination.—The visual acuity in each eye was perception of light. The ocular tension was 21·5 mm. Hg (Schiötz) in the right eye and 13 mm. Hg in the left. Both eyes showed ciliary injection, keratic precipitates, and atropine caused uneven dilatation of the pupils. Both lenses were clear, but the vitreous in both eyes was turbid with floaters precluding a clear view of the fundi. Large retinal detachments were seen in the lower parts of both eyes.

There was bilateral nerve deafness of short duration.

The reflexes were brisk in both arms and legs. The plantar reflexes were flexor.

Laboratory Investigations.—The blood pressure was 100/65 mm. Hg.

White cell count 7,800 per c.mm.; differential count, polymorphs 57 per cent., lymphocytes 46 per cent, eosinophils 3 per cent.

The erythrocyte sedimentation rate was 14 mm. in the first hour and 34 mm. in the second.

The Wassermann reaction (blood and cerebrospinal fluid) was negative.

The cerebrospinal fluid cell count was 2, total protein 20 mg. per 100 ml. Lange 0000000000. Pandy +.

* Received for publication January 18, 1958.

Treatment.—Cortisone and atropine were continued topically as above. Systemic cortisone was administered as follows: 300 mg. on the first day followed by 200 mg. on the second, and 100 mg. daily thereafter for 15 days, followed by 50 mg. daily for another 15 days. 100 mg. thiamine and 200 mg. ascorbic acid were given twice daily intramuscularly.

Progress.—On August 1, 1957, the patient's hearing was returning, and on August 5 the visual acuity had improved to 6/24 in the right eye and counting fingers at 3 ft. in the left.

Ophthalmoscopy showed a recession of the retinal detachments in both eyes. The entire background of the fundi showed a fine peppery deposit of pigment, but in certain areas the pigment was clumped together in streaks and plaques (Figs 1 and 2) distributed over the sites of the detachments.

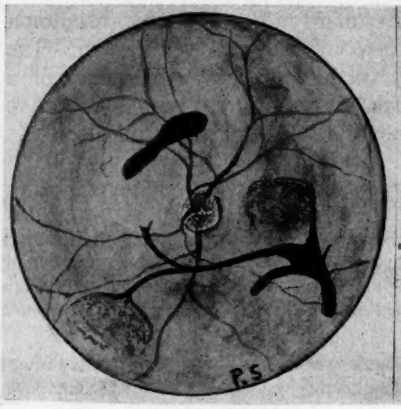

FIG. 1.—Left fundus, showing angioid streaks and pigment deposits in the form of sieves.

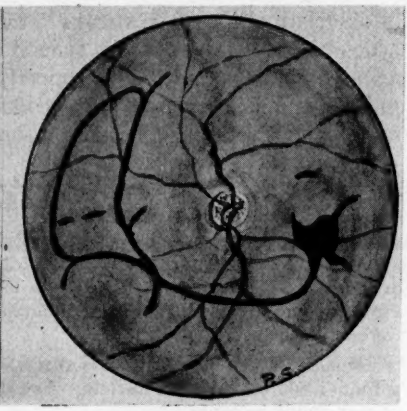

FIG. 2.—Right fundus, showing angioid streaks.

The streaks resembled those described in pseudoxanthoma elasticum, save for the darker black-brown colour, greater breadth, and curvilinear disposition. These streaks were superficial to the choroidal and deep to the retinal blood vessels. Both discs were hyperaemic with indistinct borders but without the suggestion of papilloedema. By August 15 these streaks had become less dark.

On October 6 the visual acuity was 6/18 in the right eye and 3/60 in the left. The detachments had completely disappeared and the angioid streaks were of a light brown tint.

On January 3, 1958, the eyes remained much the same. Occasional buzzing in the ears and a mild headache were residual symptoms.

Discussion

The symptomatology and course of the illness together with the beneficial effects of steroid hormone therapy leave no doubt that this was a case of Harada's uveo-meningitis, but the occurrence of angioid streaks in this condition has not been reported before. The accompanying fundus drawings suggest that the term "streaks" is inappropriate, and that "sheets" or

"plaques" would be more descriptive. The streaks were black in colour and delineated the limits of the previous retinal detachments. Wherever these streaks terminated there was the appearance of a sieve of pigment stippling the whole fundus like a fine powder.

The subsequent lightening to a brownish tint indicates that the streaks originate in a pigmentary disturbance which is characteristic of uveitis. The streaky aggregation of pigment at the limits of the retinal detachment may be explained by a stretching of Bruch's membrane brought on by a massive exudative choroiditis and concomitant serous retinal detachment. Bruch's membrane was perhaps stretched to the greatest extent at the base of the detachment, and the pigment epithelium (to which it is firmly attached, Wolff, 1948) was also subjected to strain, causing proliferation and migration of pigment. When the detachment receded with absorption of the choroidal effusion, Bruch's membrane also went back into position but showed folds and creases wherever it had been excessively stretched, somewhat resembling the folds seen in Descemet's membrane when a phase of raised ocular tension is followed by a return to low or normal tension. These folds would hold particles of pigment and give the appearance of dark streaks. When the excess pigment was engulfed by phagocytosis a brownish angioid streak would be the result.

This theory agrees with the work of Law (1938), who demonstrated histologically a folding of Bruch's membrane in pseudo-xanthoma elasticum, but the latter depends on an intrinsic defect in Bruch's membrane and not on a stretching process as in the case here described.

REFERENCES

LAW, W. (1938). *Trans. ophthal. Soc. U.K.*, **58**, 191.
WOLFF, E. (1948). "The Anatomy of the Eye and Orbit", 3rd ed., p. 47. Lewis, London.

Brit. J. Ophthal. (1958) **42**, 762.

APPLIANCES

FIXATION IN PERIMETRY AND CAMPIMETRY*

BY

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THE physiological oscillations of the eyes amount only to about 4′ and can hardly influence the result of a test of the visual field. There are, however, patients who show much larger excursions of their eyes when tested, *e.g.* nervous patients who cannot concentrate on the fixation mark and whose attention is drawn from the centre by stimuli arising in the periphery. In the case of low central visual acuity the fixation becomes unsteady. In glaucoma the impaired dark adaptation has to be taken into account. The light in the test room is usually poor and the scotopic relative central scotoma may handicap the fixation.

Two devices are described below which have proved useful to me and are simpler than the methods of Haitz and others, though in cases of unilateral absolute central scotoma one has to revert to the traditional methods.

For perimetry I use a small black metal cone mounted on the illumination box of the perimeter. The small aperture of the cone is 0·75 cm. wide and points to the fixation mark, which is 11 cm. distant (Fig. 1). Seen through the cone, the fixation mark appears to be "framed", and fixation becomes easier and steadier. As the aperture of the cone is small it does not make much difference whether a wire cross is inserted or not.

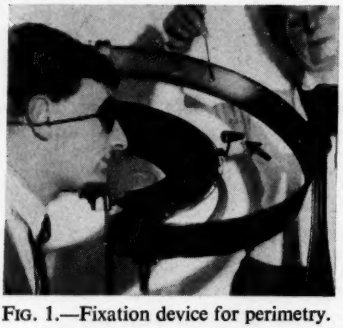

FIG. 1.—Fixation device for perimetry.

* Received for publication December 6, 1957.

My "aiming" device for the Bjerrum screen consists of a larger black truncated cone held by a handle with its upholstered smaller aperture against the orbital margin (Fig. 2). At the large aperture held away from the eye a cross wire is inserted. As the wire crossing diminishes the visibility of the fixation mark, the wires insert at a central ring of 0·6 cm. diameter which "frames" the mark. The length of the cone should be equal to the width of the large aperture. In this case the eye can see a field of 26° 40′ round the fixation mark, corresponding to the tangent of half the angle subtended at the anterior nodal point of the eye (0·5). The patient is told to aim at the fixation mark through the centre of the ring which appears in slightly diffuse lines. Thus, fixation is facilitated by the cross wires, and at the same time stimuli arising in the periphery and exciting eccentric motor impulses are eliminated.

FIG. 2(*a*).—Fixation device for campimetry.

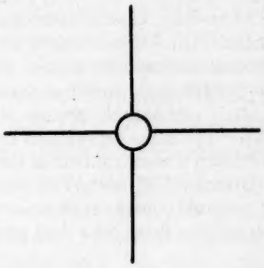

FIG. 2(*b*).—Wire cross with central ring.

The clearer view of the field obtained by these devices cannot be due to a stenopaeic effect as the aperture is too large. The Bjerrum cone protects the eye as a hood protects the lens of a camera from diffuse peripheral light. The simultaneous contrast at the dark rim of the cone may have some influence, but the steadying of fixation is apparently more important for the improvement of the visibility.

Brit. J. Ophthal. (1958) **42**, 764.

CORRESPONDENCE

RHINOSPORIDIOSIS

To the Editorial Committee of the BRITISH JOURNAL OF OPHTHALMOLOGY

SIRS,—Rhinosporidiosis of the conjunctiva is perhaps not so uncommon as your readers might gather from the article which appeared in your September issue (Sharma, Shrivastav, and Agarwal, 1958). My notes reveal that an average of about two cases per annum were seen at the Government Ophthalmic Hospital, Madras; so that in my 18 years there I must have seen more than 25 cases, some no doubt associated with a lacrimal or nasal invasion. Certain of these are recorded in sundry places. One curious feature of the conjunctival growths is that when they are bulbar they nearly always show scleral thinning and staphyloma related to the seat of attachment of the pedicle. I only once saw a bulbar conjunctival growth not associated with scleral staphyloma: it was very small (2·5 mm. diameter) and flattened, and had not yet developed a pedicle. In the Annual Report of the above hospital for 1922, I discussed this staphyloma production and concluded that it was an atrophic condition associated with the mechanical effects of the constantly dragging pedicle. The sclera overlaid by a palpebral growth and subjected to the pressure of the little flattened tumour always appeared to remain normal. Your contributors mention male predilection, and this strange feature apparently applied to conjunctival invasion in the fairly comparable groups of children of opposite sexes to which I referred (Wright, 1922). The same report also mentioned the failure to transmit the parasite to monkeys in a limited trial carried out at the King Institute, Guindy, in association with Cunningham, the Director. *R. seeberi* as a human parasite shows a number of interesting characters and, as your contributors say, "should always be kept in mind as a possibility in India," especially by those who deal with diseases of the eye, ear, nose, and throat.

Yours faithfully,
R. E. WRIGHT.

33 CHURCH ROAD,
FLEET, HANTS.
October 5, 1958.

REFERENCES

SHARMA, K. D., SHRIVASTAV, J. B., and AGARWAL, S. (1958). *Brit. J. Ophthal.*, **42**, 572.
WRIGHT, R. E. (1922). *Indian med. Gaz.*, **57**, 82.

BOOKS RECEIVED FOR REVIEW

The following books will be reviewed in *Ophthalmic Literature*, Vol. 12, No. 3, March, 1959:

The Blind Child. (L'enfant aveugle). By P. BAILLIART. 1958. Pp. 103. Doin, Paris. (700 *Fr. frs*).

Physiology of Vision in the Premature and in the Normal Infant. (Physiologie de la vision chez le prématuré et le nourrisson normal). By I. ESENTE. 1958. Pp. 127, 172 figs. Doin, Paris. (1,600 *Fr. frs*).

Ocular Pathological Anatomy. Second Series. (Travaux d'anatomie pathologique oculaire. 2e séries). By F. HERVOUËT. 1958. Pp. 220, 452 figs. Masson, Paris. (4,000 *Fr. frs*).

Chronic Tetany or Spasmophilia. (Le tétanie chronique ou spasmophilie). By H. P. KLOTZ. 1958. Pp. 259, 23 figs, 380 refs. Expansion scientifique française, Paris.

Brit. J. Ophthal. (1958) **42**, 765.

NOTES

XVIII International Congress of Ophthalmology

Brussels, 1958

The XVIII International Congress of Ophthalmology took place in Brussels from September 8 to 12, 1958; since the First Congress was convened in Brussels in 1857, this acted as a centenary meeting and was undoubtedly one of the most successful of the century-long series.

During the week before the Congress two international symposia were held —one sponsored by the Council for International Organizations of Medical Sciences on "The Transparency of the Cornea", the other by the University of Liège on "Glaucoma".

The first symposium, for which François acted as organizing secretary, was held in the delightful hotel, La Réserve, in the seaside town of Knokke-Le Zoute. Duke-Elder (*London*) was chairman, and the participants were: Ashton (*London*), Charamis (*Athens*), Cogan (*Boston*), Dohlman (*Lund*), Franceschetti (*Geneva*), Grignolo (*Cagliari*), Harris (*Portland, Oregon*), Langham (*London*), Leigh (*London*), Maumenee (*Baltimore*), Maurice (*London*), Michaelson (*Jerusalem, Israel*), Paufique (*Lyon*), Rabaey (*Ghent*), Smelser (*New York*), Vail (*Chicago*), van Walbeek (*Zaandam, Holland*), and Weimar (*New York*). Perkins (*London*) and Mme. Hanstrate (*Ghent*) acted as secretaries. The subject was treated under five headings: the anatomy and development of the cornea; its physical structure; its metabolic activity; pathological changes in trauma, vascularization, and degeneration; and problems associated with the maintenance of transparency in corneal grafts. Introductory papers on each aspect were followed by long discussions, always animated and interesting, and sometimes fruitful. The proceedings of the symposium will be published as a book in the near future.

In the symposium on glaucoma at Liège, Goldmann (*Berne*) was president, R. Weekers (*Liège*) was organizing secretary, and the following participated: Bárány (*Uppsala*), van Beuningen and Fischer (*Tübingen*), Dubois-Poulsen and Magis (*Paris*), François and Neetens (*Ghent*), Gloster (*London*), Harms and Aulhorn (*Tübingen*), Kinsey (*Detroit*), Leydhecker (*Bonn*), Linnér (*Göteborg*), Prijot (*Liège*), von Sallmann (*Bethesda, Maryland*), and Weekers, Gougnard, and Lavergne (*Liège*); Nordmann (*Strasbourg*) acted as publication secretary. The general subjects discussed were the physiology of the intra-ocular pressure and aqueous humour, tonometry and tonography, and the relative values of various methods of investigation in the early diagnosis of glaucoma. The proceedings of the symposium will appear in due course in *Documenta Ophthalmologica.*

The International Congress itself was held in the Palais des Beaux Arts in the centre of Brussels, the ample accommodation of which allowed the whole

of the organization and the scientific sessions to take place conveniently in one building; the Grande Salle de Concert seated 2,000 people, four other smaller halls allowed five sessions to be held simultaneously, and sufficient room remained for the elaborate scientific and technical exhibitions and for refreshments. Léon Coppez acted as President, Jules François as Secretary-General, R. Weekers as Treasurer, and J. Michiels as Editor of Publications. There were 1,778 full members, with 58 scientific associates and 993 associates, a total of 2,829 drawn from 76 nations—a number greater than at any other international ophthalmological congress except the XVII Congress at Montreal–New York. The administrative languages were French, English, and German.

The opening ceremony, which took place on the morning of September 8 in the presence of Her Majesty Queen Elisabeth of Belgium who occupied the royal box in the Grande Salle de Concert, followed the now recognized procedure: the Congress was formally opened by the President, and there followed a speech of welcome by the President of the International Council, who then presented the Gonin Medal to Alan Woods (*Baltimore*) in the name of the Queen. These formal procedures were followed by an address by the President of the Congress, an address by the President of the International Council, who spoke of the value of the contributions of Belgium to ophthalmology, an address by the official representative of the World Health Organization (Maxwell Lyons) and inaugural speeches by representatives of the five continents: Renard (*Paris*) for Europe, Vail (*Chicago*) for North America, Cyro de Rezende (*São Paulo*) for South America, Kirisawa (*Tokyo*) for Asia, Staz (*Johannesburg*) for Africa, and Ringland Anderson (*Melbourne*) for Australasia. After the inaugural ceremony the official group photograph was taken.

The main features of the scientific part of the Congress were two official discussions: "The Orthoptic Treatment of Concomitant Squint," opened by Bangerter (*St. Gallen*), Keith Lyle (*London*), and Malbrán (*Buenos Aires*); and "Senescence in Ophthalmology", opened by Bürger (*Leipzig*), François (*Ghent*), and Jayle (*Marseilles*). In addition, there were five symposia each introduced by a panel of speakers: on the genesis of functional symptoms in an eye with raised tension, on radioactive isotopes, on electroretinography, on the aetiology of cataract, and on the preventive treatment of idiopathic and secondary retinal detachment. There was also a vast number of "free" papers (the programme contained 149 of these), and appended to the main discussions and symposia were a further 135 communications. Fortunately all the intending speakers did not appear. It is becoming more and more apparent that in future congresses this vast bulk of scientific information—much of it of little value—might well be curtailed, and symposia, for example, limited to the discussion of various aspects of the subject by a small number of invited speakers, followed by spontaneous comment from the floor. As in most international meetings nowadays the most popular, and perhaps the

most useful, feature was the showing of films (90)—the most effective method of communication in a multilingual audience. The language problem, however, was overcome to a considerable extent by simultaneous translation into the three administrative languages of all papers and speeches in the main conference hall—the first time this has been attempted in an ophthalmological congress. The translations were excellent and were maintained without interruption by a staff of interpreters, except on a few occasions when a speaker ran away with himself in his haste or enthusiasm.

Simultaneously with the main congress, the annual meetings of the International Association for the Prevention of Blindness and the International Organization against Trachoma were held. The former, under the presidency of Franceschetti (*Geneva*), had as its main themes industrial accidents and the visual education of the legally blind and partially sighted child. At the latter, under the presidency of Bietti (*Rome*), Nataf (*Tunis*) ably presented a report prepared by himself and Thygeson (*San José*) on the aetiology of trachoma, but the most important scientific contribution to the meeting—and, indeed, to the entire Congress—was the unequivocal demonstration of the culture of the virus of trachoma in embryonated eggs by Collier (*London*) and of its transmission to human subjects and baboons.

The closing ceremony, held on the afternoon of September 12, was preceded by the business session of the International Federation of Ophthalmological Societies. Representatives of six continents made suitable speeches: Pillat (*Vienna*) for Europe, MacDonald (*Toronto*) for North America, Courtis (*Buenos Aires*) for South America, Nguyen Dinh Cat (*Vietnam*) for Asia, Abdel Mohsen Soliman (*Cairo*) for Africa, and Bignell (*Melbourne*) for Australasia. These were followed by a speech of thanks by the President of the International Council of Ophthalmology and by graceful speeches of appreciation by the President and Secretary-General of the Congress.

The Exhibitions were an important feature of the Congress. The scientific section comprising fifty-one exhibits had a wide range in clinical and pathological subjects, many of them of unusual interest; among those which attracted wide attention were demonstrations of the fine structure of the eye by Jakus (*Boston*), the stereoscopic anatomical and pathological illustrations of Donaldson (*Boston*), and the viewing of the fundus oculi by television presented by H. Ridley. (*London*)—a suggestion of long-distance clinical consultations to come? The trade exhibition comprising fifty-two stands from instrument makers from many countries was of equal interest.

Perhaps the most outstanding feature of the Congress, however, was the warmth and excellence of the social events. On the evening before the congress opened the Belgian Committee provided a sumptuous reception at the "Cinquantenaire", one of the Musées Royaux d'Art et d'Histoire. On the Monday night there was an even more splendid reception and dance at the Hôtel de Ville of Brussels, the whole of which was thrown open for the occasion; few cities possess a civic centre of such beauty and charm as

well as of such historic interest, and few international occasions can have taken place in an atmosphere so ideal and gay. On the Tuesday night a unique performance was given in the Théâtre Royal de la Monnaie, wherein the folklore of mediaeval Belgium was portrayed by the aristocratic Society of the Ommegang. On Wednesday afternoon and evening the members of the Congress were given a special invitation to the Universal Exhibition where Baron Moens de Fernig, Commissioner-General for the Exhibition, gave a reception at the Belvedere Palace. On the Thursday night the official Banquet took place, when covers were set for 1,100 guests, the speakers being M. Victor Larock, an ex-foreign minister of Belgium, S. Duke-Elder (*London*), Alan Woods (*Baltimore*), and H. K. Müller (*Bonn*); the menu contained an ingenious isochromatic plate combining the two dates of the international congresses in Brussels, 1857 and 1958. All through the congress the Belgians, from Queen Elisabeth downwards, gave a series of lunches and parties; and all the time the Universal Exhibition attracted congressists and associates in great numbers to see the bewildering display of cultural, scientific, and industrial exhibits which had been contributed by all the nations of the earth from the mightiest to such fairy-tale states as Andorra, Monaco, and Liechtenstein, staged—so it seemed—for the special benefit of the congressists. Nor, associated with the exhibition, should the carefree nights of revelry in *Belgique Joyeuse* be forgotten—a cleverly reconstructed township of 1900, in which every house seemed to be a cafe or a cabaret and in every one at least two orchestras.

Two of the most delightful events followed the official closing of the meeting. The first, on the Friday evening, was an expedition organized by de Jaeger to the ancient and beautiful town of Bruges; few of the 1,095 who went will forget the gaiety and spontaneity of the feast, the attendants and the orchestra dressed in mediaeval costume and the menu and the beer (the mug a gift to each guest) of the same robust vintage. Nor will the flood-lit beauty of the ancient town seen after dinner, nor the magic of its canals be forgotten. The second event was equally pleasurable—a visit to Ghent, where François received some 600 guests at a fascinating exhibition illustrating the Golden Age of Great Cities in St. Peter's Abbey, and entertained them to lunch thereafter in its spacious cellars.

Altogether the meeting was everything a congress can hope to be; indeed, it was more than that because of the warmth and kindliness of our Belgian hosts who spared no effort to make the event not so much a formal scientific gathering as a family party of old and newly-met friends. And undoubtedly much of its success was due to the omnipresent, omniscient, and ever-smiling Secretary-General.

STEWART DUKE-ELDER

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DUKE-ELDER, S.: A Century of International Ophthalmology (1958) 442
ERBAUGH, J. K.: Principles of Ophthalmoscopy *(1958)* *442*
FASANELLA, R. M. (editor): Manage*ment of* Complications in Eye Surgery (1957) *443*
FILATOV, V.: My Path in Science, *trans. G. H. HANNA (1958)* ... *442*
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Book Reviews (*Contd.*):
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HANSELL, P.: A System of Ophthalmic Illustration (1957) ... 320
LYLE, H. W., and LYLE, T. K.: Applied Physiology of the Eye (1958) 383
NATAF, R. 639
NEUROLOGICAL SURGEONS CONGRESS, (Chicago, 1956): Clinical Neurosurgery, Vol. IV (1956) 508
OBRIG, T. E., and SALVATORI, P. L.: Contact lenses (3rd ed., 1957) 382
PATON, R. T., KATZIN, H. M., and STILWELL, D.: Atlas of Eye Surgery (1957) 127
PAU, H.: Reaktive Zellveränderung in Hornhaut und Netzhaut (Reactive Cellular Changes in the Cornea and Retina) (1957) *318*
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SÉDAN, J., JAYLE, G. E., MALBRÁN, J., *FRANÇOIS, J., and* CALAMANDREI, G.: Thérapeutique médicale oculaire (1957) ... 255
SERR, H.: *Axenfeld's Text-book and* Atlas of Ophthalmology (10th ed., 1958) 384
SMYTHE, R. H.: Veterinary Ophthalmology (2nd ed., 1958) ... 444
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VAIL, D. (editor): Year Book of Ophthalmology, *1957–1958 (1958)* *443*
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YASARGIL, M. G.: Die Röntgendiagnostik des Exophthalmus unilateralis (X-ray Diagnosis of Unilateral Exophthalmos) (1957) 61

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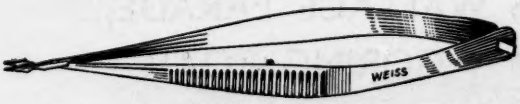

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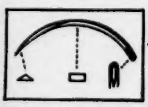

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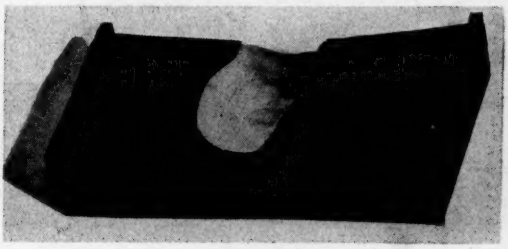

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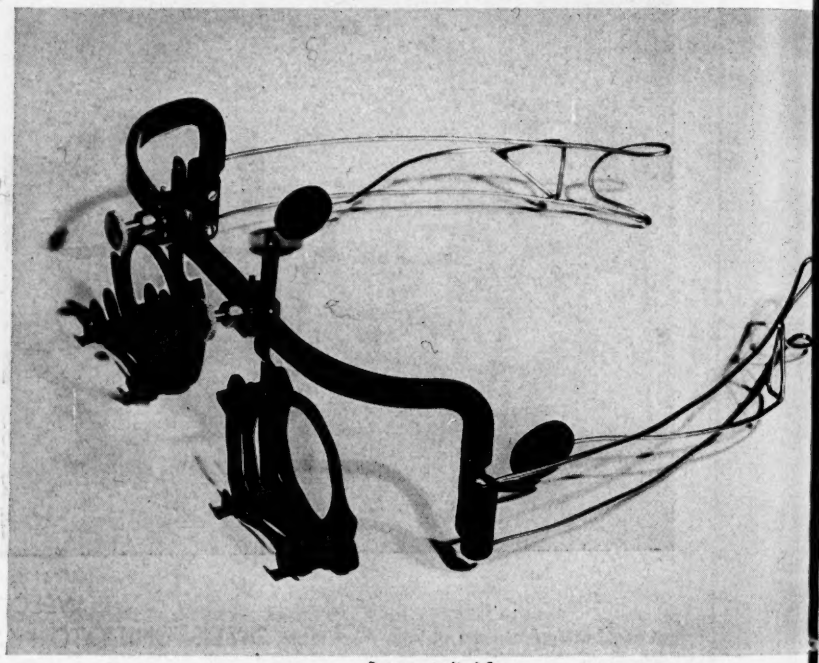

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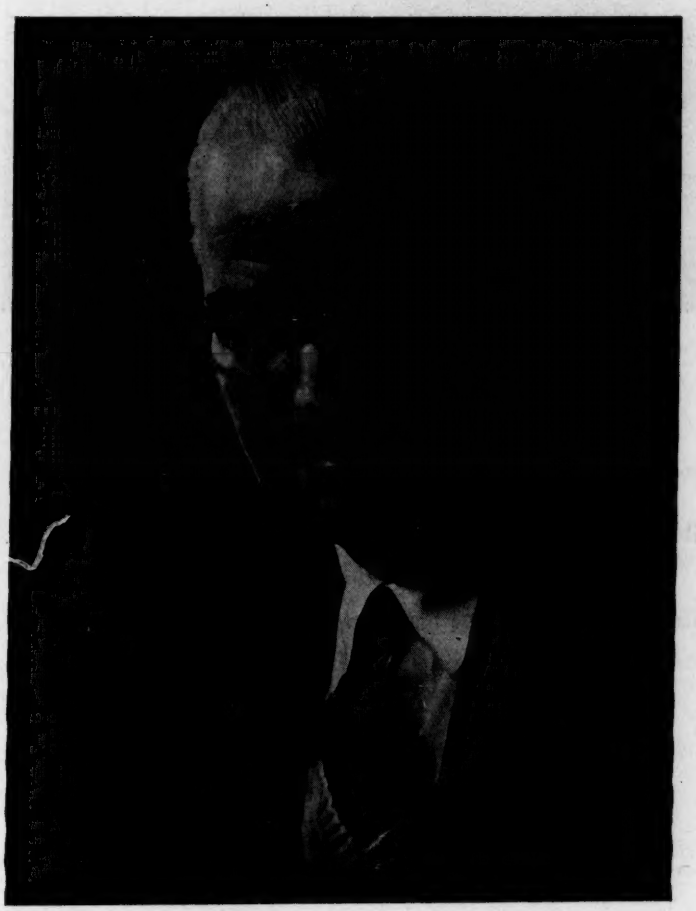

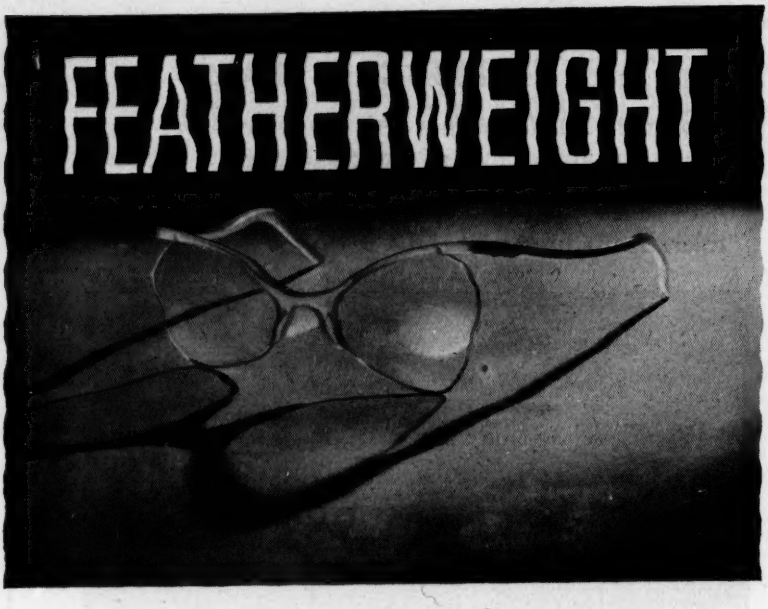

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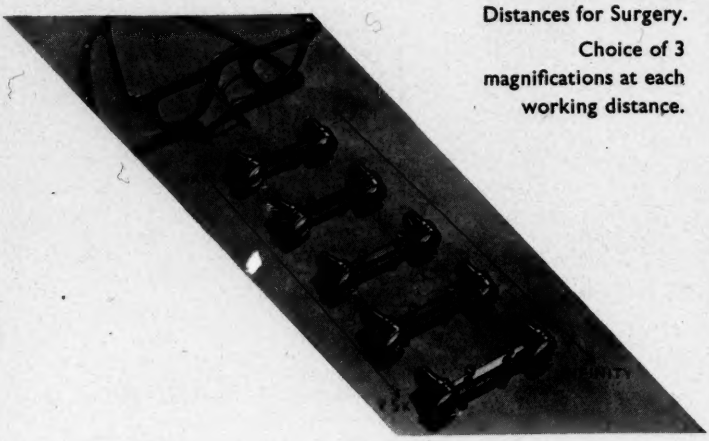

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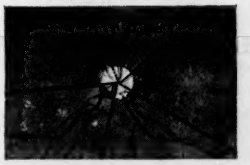
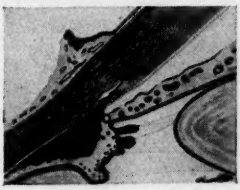
Miniature No.	Condition.
MF 1.	Blonde Fundus.
MF 3.	Medium British Fundus.
MF 2.	Tigroid Fundus.
M4 4.	Negro Fundus.
MF 5.	Physiological Cupping.
MF 6.	Myopic Atrophy of Choroid.
MF 7.	Opaque Nerve Fibres.
MF 8.	Pseudo-Papilloedema.
MF 9.	Glaucomatous Cupping.
MF 10.	Primary Optic Atrophy.
MF 11.	Secondary ,, ,,
MF 12.	Retinitis Pigmentosa.
MF 13.	Papilloedema.
MF 14.	Myopic Detachment.
MF 15.	Melanomatous Detachment.
MF 16.	Haematogenous Haemorrhages.
MF 17.	Embolism of Central Artery.
MF 18.	Thrombosis of Central Vein.
MF 19.	Acute Choroiditis.
MF 20.	(Tays) Colloid Deposits at Macula.
MF 21.	Old Choroiditis.
MF 22.	Diabetic Retinitis.
MF 23.	Albuminuric Retinitis.
MF 24.	Advanced Arterio-sclerosis.
MF 25.	Miliary Tuberculosis.
MF 26.	Diabetic Lipaemia.
MF 27.	Albinotic Fundus.
MF 28.	Rupture of the Choroid.

The John Foster Comparative Pictures of Fundus Changes of General Diagnostic Significance.

Miniature No.	Condition.
MF 29.	Normal Abnormalities.
MF 30.	Pigmentary Variations.
MF 31.	Disc Changes.
MF 32.	Haemorrhages.
MF 33.	Detachments, Choroiditis
MF 34.	Disc Changes.
MF 35.	Disc Changes.





The above illustrations are full size.

Other slides will be added from time to time.

EXTERNAL APPEARANCES

Miniature No.	Condition.
ME 1.	Rosacea Keratitis.
ME 2.	Amaurosis from Glioma.
ME 3.	Angular Conjunctivitis.
ME 4.	Blepharitis.
ME 5.	Cuneiform Cataract.
ME 6.	Congenital Lamellar Cataract.
ME 7.	Chalazion.
ME 8.	Ophthalmic Neonatorum.
ME 9.	Dendritic Ulcer.
ME 10.	Phlyctenular Ulcer.
ME 11.	Hypopyon Ulcer.
ME 12.	Prolapse of Iris (traumatic)
ME 13.	Cyclitis, K.P., occlusio.
ME 14.	Dacryocystitis, acute.
ME 15.	Dislocation of Lens (posterior).
ME 16.	Epicanthus.
ME 17.	Episcleritis.
ME 18.	Acute congestive glaucoma.
ME 19.	Interstitial Keratitis.
ME 20.	Pterygium.
ME 21.	Ectropion.
ME 22.	Entropion and Trichiasis.
ME 23.	Trachoma.
ME 24.	Spring Catarrh.
ME 25.	Disciform Keratitis.
ME 26.	Follicular Conjunctivitis.
ME 27.	Pinguecula.
ME 28.	Coronary Cataract.
ME 29.	Hordeolum.
ME 30.	Iritis/Glaucoma (J. Foster).
ME 31.	Concomitant and Paralytic Strabismus.
MD 1.	Section through angle of anterior chamber.
MD 2.	Tear Cycle.
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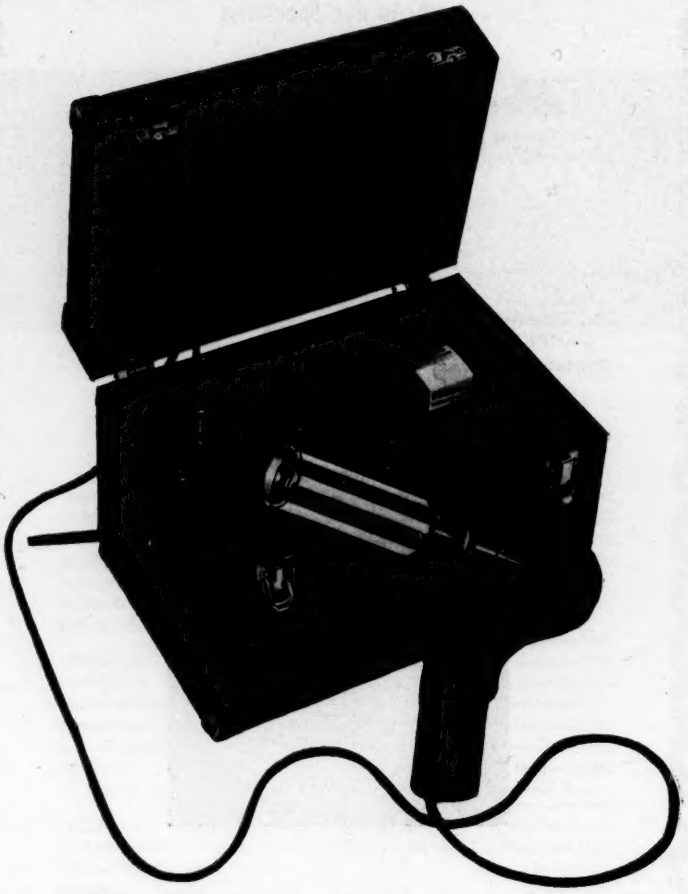

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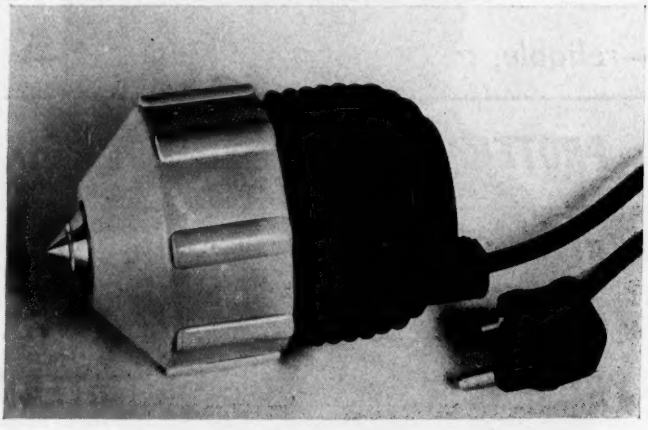

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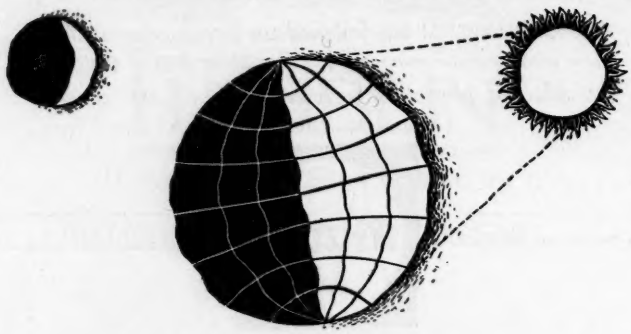

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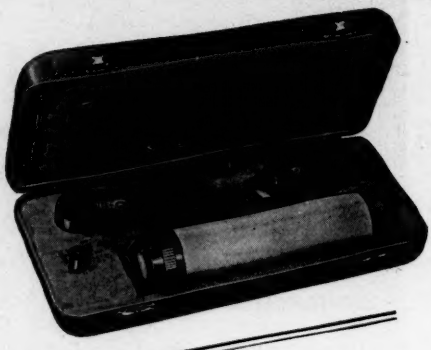

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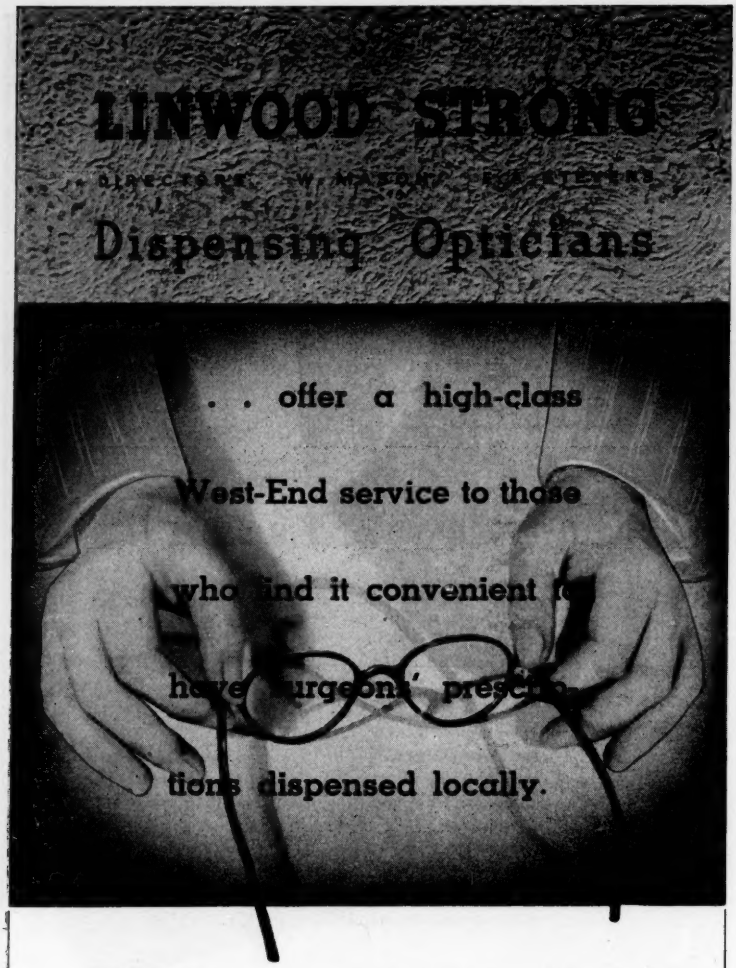

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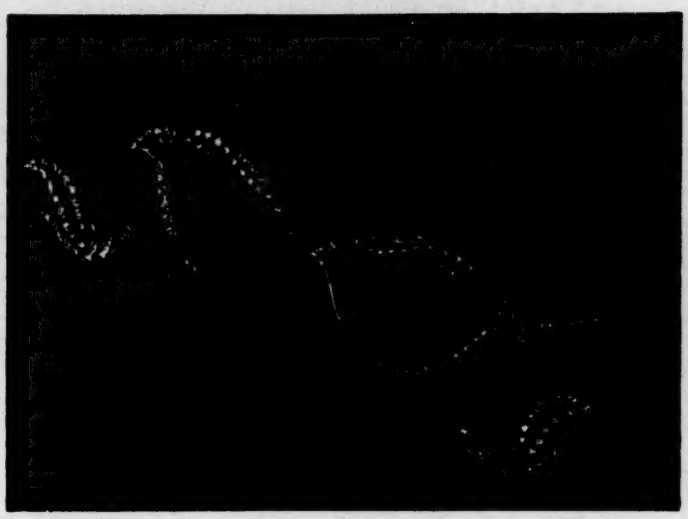

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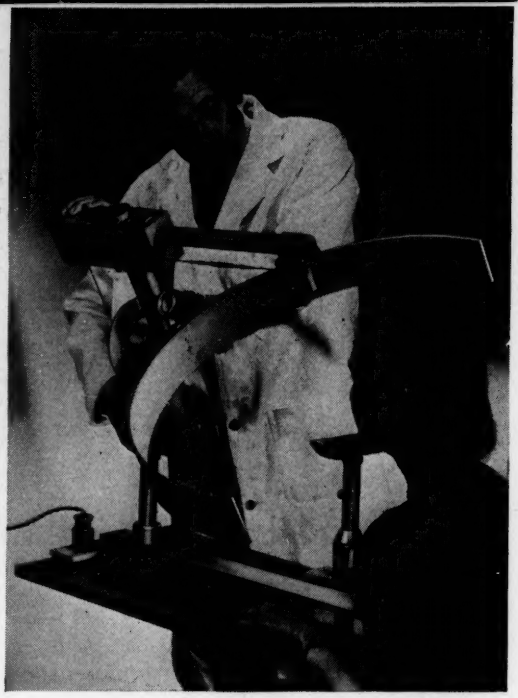

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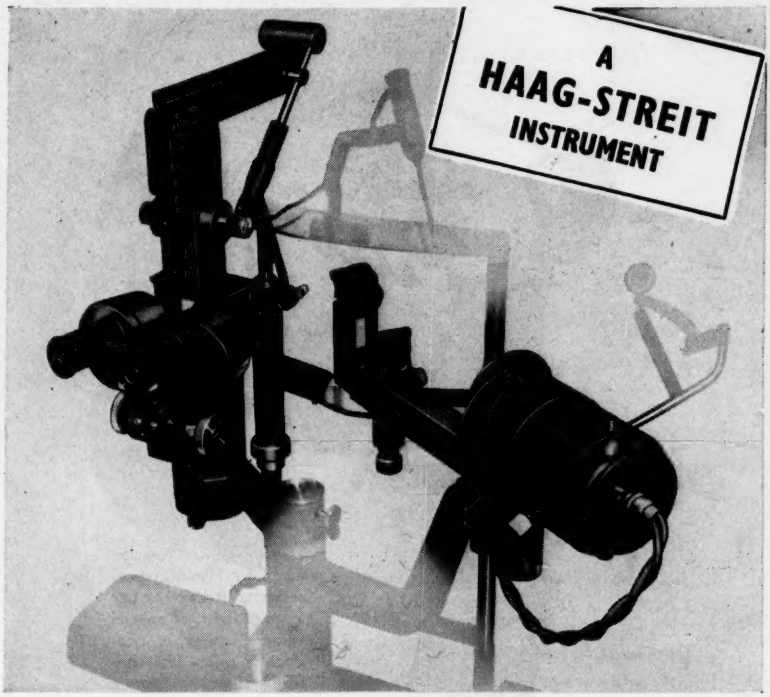

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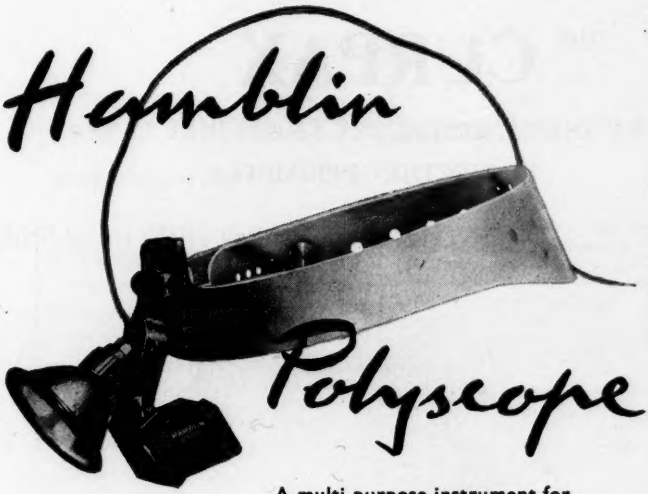

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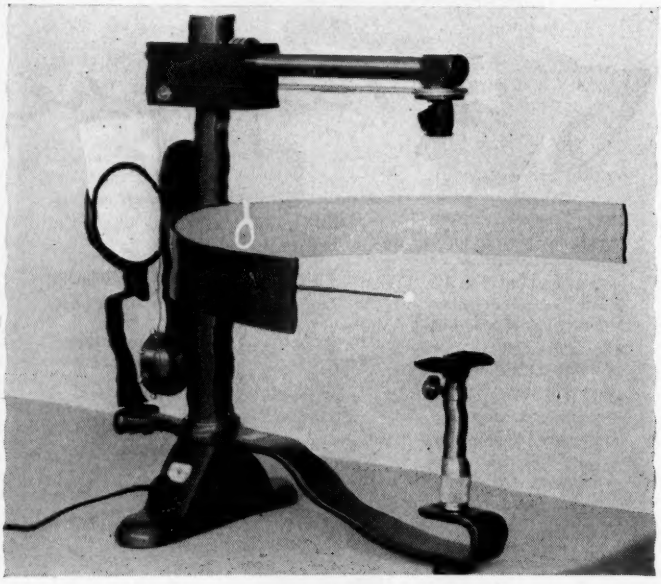

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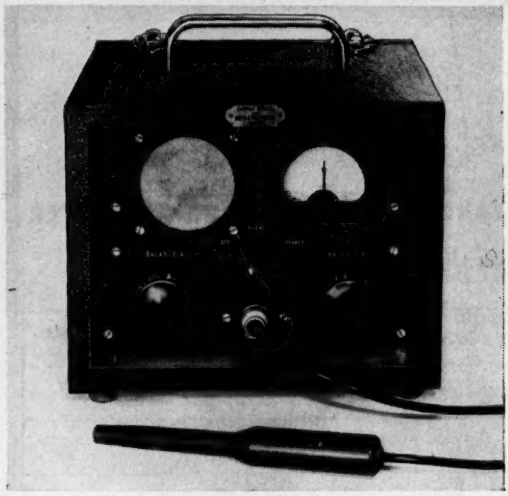

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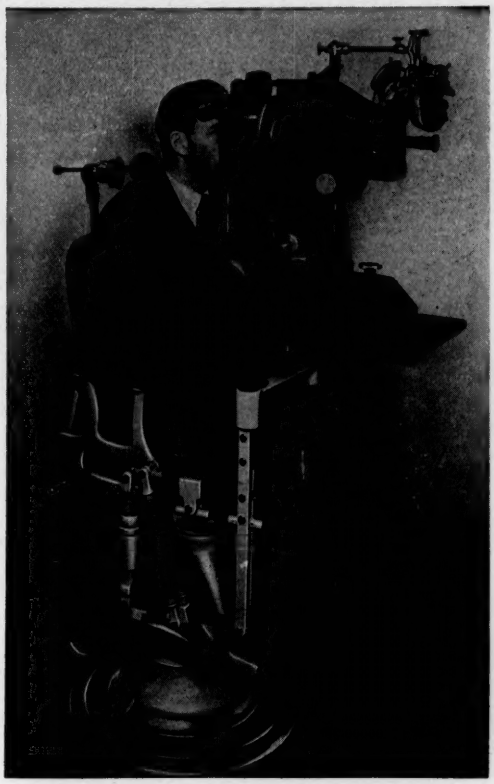

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Anyone who wishes to present a paper, a communication or a demonstration should contact the Secretary of the Society, Dr. F. Schwab, 1st University Eye Clinic, Vienna 9, Alserstraße 4, not later than February 15, 1959.

Papers are limited to 15 minutes, communications to 10 and demonstrations to 5 minutes.

The final programme will be announced on March 1st, 1959.

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